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AUTHOR Gilsdorf, Russell H., Jr.
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ABSTRACT

Presented are the results of a study conducted by a junior high school teacher with his own classes. The study is divided into two parts. The first part of the study attempted to improve mathematics attitude with enrichment activities. The second part attempted to change student attitudes by designing the curriculum according to parental specifications. In both parts, changes in attitude were compared with changes in mathematics achievement. Results indicated that attitude and achievement do not go hand-in-hand. (MK)

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ATTITUDES TOWARD MATHEMATICS IN THE JUNIOR HIGH SCHOOL

August 1975

Russell H. Gilsdorf, Jr.

SE 029 844

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PREFACE

This paper represents an attempt to summarize some useful ideas for guiding children through the hazards of learning mathematics. It is a paper for teachers more than it is a paper for researchers--and it is a paper for myself more than it is a paper for others.

Information about attitudes and achievement, and the relationship between these is presented.

I wish to thank Sara Chalmers and Alma Ecklund for their large contributions in implementing my cumbersome programs, and Vernon Gross for his support. Thanks goes to my advisors, Professors John David Miller and Lawrence F. Lowery for allowing me to pursue my greatest interests in this field and for being available and supportive. Thanks, too, to the Lawrence Hall of Science, Berkeley, California, for contributions of a computer terminal and computer time--and for just being a great resource of teaching materials. Special thanks goes to my daughter Lill who did a lot of swimming while I worked on this study.

INTRODUCTION

Attitude and Education

The development of positive attitudes has become a central objective in the creation of new science curricula at all levels (Lowery [1]). And in the field of mathematics heavy emphasis has been placed on the importance of attitude in causing students to learn mathematics (Neale [2]). Roberts [3] goes even beyond science and math in stating that (most) teachers are aware of the importance of attitudes in the acquisition of (any) knowledge.

Accordingly, this study concerns itself with the engendering of positive attitudes toward the study of mathematics, and with providing classroom conditions which foster such attitudes.

The study is in two parts. The first, conducted in the academic year 1973-74, attempted to improve math attitude with certain enrichment activities described below under the heading "Math Lab." The second experiment occurred in 1974-75, and attempted to change student attitudes indirectly by designing the curriculum according to parental specifications.

In both experiments changes in attitude were compared with changes in math achievement.

Chapter 1

THE FIRST EXPERIMENT: EFFECT OF MATH LAB ACTIVITIES ON STUDENT MATH ATTITUDES

The Population

Both experiments were conducted in a northern California junior high school where I was teaching. The setting was a small urban community forty miles from San Francisco. It was racially mixed, 77% white, 16% black, 7% Filipino. It relies heavily on a local naval base for its middle-low to low-middle income. The school itself was carrying, besides its normal enrollment, half the students from a structurally condemned junior high school in the same district, which was racially 60% white, 25% black, 15% Filipino.

Test Instruments

The same instruments were used in each study. Math attitude was defined in terms of scores on a math attitude inventory* (Appendix A) which I developed myself, and math achievement in terms of a math diagnostic developed by Bonnie Bernhardt (Appendix B).

---

*For details on the weakness of this kind of measure, see Knapp [5].

No test characteristics were available for use with junior high school students for either the attitude inventory or the math diagnostic, although the inventory had been used with graduate students and had been improved in regard to item analysis and reliability. Its reliability (split-half) for graduate students was 0.77. Part of the objective for the study was to obtain reliability estimates for the same attitude inventory when it was used with junior high students. Another part was to obtain validity estimates from correlation with achievement. Achievement would be measured by the diagnostic and by the CTBS.* (Aiken [4] and Neale [2] report that attitude affects achievement and achievement affects attitude; therefore these correlations should give a measure of concurrent validity to the math attitude inventory.) And finally I would want a reliability estimate for the diagnostic with the CTBS. This last estimate would give a measure of validity for the diagnostic test.

The Problem

The central question of this study was whether certain enrichment activities, when they replaced part of the normal curriculum in a junior high math class in my school, would improve attitudes toward mathematics.

---

*Comprehensive Test of Basic Skills, California Test Bureau, McGraw-Hill.

The Math Lab

The enrichment activities included:

1. Experiments in rocketry using balloons.

2. More experiments in rocketry using balls, cans, and water to demonstrate pressure, weight and other physical properties.

3. The firing of a rocket.

4. Many activities using math games such as towers of Hanoi, pegboards, Kallah, etc.

5. Videotaping of class activities.

6. Showing videotapes--tapes of the class, a tape made by other kids about the Lawrence Hall of Science.

7. Disassembling electric and electronic equipment.

8. Dice games.

9. Magic tricks.

10. Topological tricks and games.

11. Card tricks based on mathematical principles.

12. Special films (from NASA, CARE, public libraries).

13. Computer games from the computer library at the Lawrence Hall of Science. I was able to borrow a Data-Point console with which we could get access by phone to the LHS* computer. We used ELIZA and BLKJCK. ELIZA converses with the user, BLKJCK plays blackjack with several users at one time.

---

*Lawrence Hall of Science, University of California, Berkeley.

The Population Samples: The Groups

I chose three of my own math classes for this study.

All math classes were designated by the school as 78A, 78B, 78C, 89A, 89B, or 89C. The numbers 78 and 89 indicated that the classes were either for seventh and eighth graders (78) or for eighth and ninth graders (89), and the letters indicated tracks A, B, and C from upper to lower, respectively.

For my contrast group (C) I chose my 89B class; for my experimental group (E) I chose my 78B class. These classes would at least have the commonness of a majority of "B" students. The third class, the reference group (R) was for further contrast.

Each group had the same ratio of boys to girls, one third of each class being girls.

It appears that the math lab was the first of its kind in the school and that none of the students had previous experience in the activities included in the math lab.

During the course of the experiment the two groups C and E had the same basic curriculum. They worked on individualized lessons developed by teachers in Long Beach, California. The lessons are known to me only by the name of the Long Beach Materials. Because there are about 200 lessons, ranging in length from one to six pages each, it is not possible to append a set of the lessons. However, part of a sample lesson is attached (Appendix C).

Treatment

The Math Lab took place one class period per week for a school year in Group E.

Evaluating the Results

The attitude of group E did not improve (see Appendix G, Displays of Data VI, VII, VIII). Table 1 shows, in fact, that the mean score declined. The group might have had other enrichments, but in terms of the scores on the attitude inventory the group was not improved.

Table 1

Mean Scores

Date	Class	Mean Attitude	Mean Diagnostic	Mean CTBS
9-11-73	Experimental	20.15	15.74	451
2-10-74		18.79	13.25	-
6-12-74		19.29	18.53	479
9-11-74	Contrast	20.31	19.78	473
2-10-74		23.69	20.00	-
6-12-74		24.55	26.80	502
t-ratio			2.52*	
9-11-74	Reference	25.86	28.29	527
2-10-74		22.79	29.31	-
6-12-74		19.82	27.85	551

*Significant at 0.025 level of confidence.

Furthermore, Group E's scores on the diagnostic did not improve significantly.

The Long Beach materials improved achievement in terms of the diagnostic and the CTBS. And the improvement

was significant at the 0.025 level of confidence.

Figure I (page 8) shows graphs for each class of the changes over the year in attitude and achievement. It is clear from these graphs, together with the evidence presented above, that the Long Beach system improves the measured characteristics, and that whatever else I was doing induced declines in the characteristics, and that a combination of the two systems (i.e. the combination of Long Beach with Math Lab, as in Group E) brought about a compromise of the two extreme effects.

Test Characteristics

Table 2 gives three separate reliability estimates over the year for both the attitude inventory and the achievement test.

Table 2

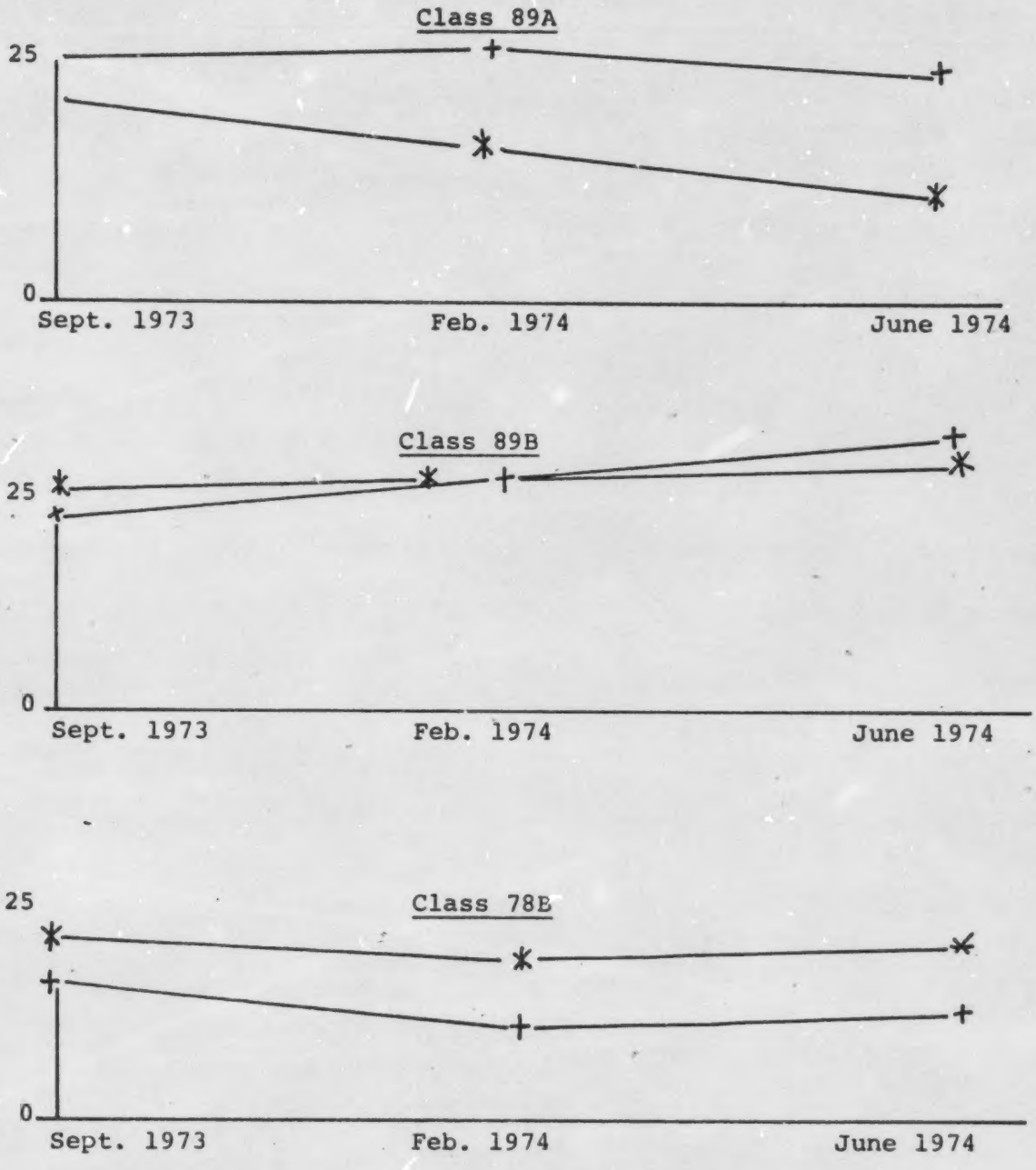
Reliability of Attitude Inventory

Date	Split-half Coefficient with Spearman-Brown Correction
9-11-73	0.73
2-10-74	0.83
6-12-74	0.91

Reliability of Math Diagnostic

Date	Split-half Coefficient with Spearman-Brown Correction
9-11-74	0.84
2-10-74	0.78
6-12-74	0.90

Figure I. Mean Scores



* Attitude Mean Score

\+ Achievement Mean Score

Both tests had strong reliability estimates in September, which became even higher as the year progressed, notably in June.

If the correlation, however, of attitude with achievement were to be a measure for validity of the attitude inventory, then Table 3 indicates a weakness in this characteristic of the test.

Table 3

Correlation Between Attitude and Achievement

A. Correlation of Attitude Inventory Scores with Scores on Math Diagnostic Using All Scores from 89A, 89B, and 78B

Date	r
9-11-74	0.43
2-11-74	0.38
6-10-74	0.31

B. Correlation of Attitude Inventory Scores with Scores on CTBS Using All Scores from 89A, 89B, and 78B

Date	r
9-11-74	0.40
No February test given.	
6-10-74	0.11

C. Correlation of Math Diagnostic with CTBS Using All Scores from 89A, 89B, and 78B

Date	r
9-11-73	0.80
No February test given.	
6-10-74	0.69

Yet my faith remained with the inventory because an item such as "I always like division problems (true, false)," as found on the inventory is a better sample of the content

of math attitude than is "Solve the following division problem: $24\overline{)1345}$," as found on the achievement test. The split-half was, then, a better measure of validity than was the correlation with achievement.

I assumed then that the tests were useful measures and that I would continue to use them.

Chapter 2

THE SECOND EXPERIMENT: EFFECT OF PARENT INVOLVEMENT ON STUDENT MATH ATTITUDE

Changes in mean attitude scores were unpredictable in terms of other measures.

Table 4

Disciplinary Actions Taken

Class	Aides	Referrals	Suspensions	Expulsions
Experimental	0	0	0	0
Control	2-3	32	3	1

Table 4 indicates the disciplinary actions taken in each class. The number of aides refers to the number of aides usually required to maintain classroom control. In addition it was felt by the teacher that the attitude of the C class was very negative toward the curriculum, the teacher, and perhaps even toward the school, whereas the most negative feelings in the experimental class were those expressed in protest against cancellation of the math lab.

Adolescence and Schizophrenia

The magnitude of the unpredictability of the students' feedback seemed to approach schizophrenic proportions. Some support for this notion was obtained from Barker [7]:

> . . . the problems of distinguishing between difficulties of adjustment to the adolescent role and more serious disorders such as early schizophrenia are considerable.

Considerable also, unfortunately, would be the task of interpreting adolescent communications if these were analyzed the same way one would analyze schizophrenic communications.

An Indirect Approach to Attitude Modification

Erikson [8] provided a clue which encouraged bypassing the problem of communicating with the students and encouraged communicating instead with the students' parents. Communication, after all, is simply a means to an end, the end being to improve math attitude.

The encouragement to communicate with the students indirectly through their parents came from Erikson's definition of education: Education is the process of preparing a child for successful participation in his parents' society (or subculture).

A questionnaire was developed which surveyed the parents' expectations in terms of their child's preparation for an adult vocation. Every attempt would then be made to prepare the students to fulfill their parents' expectations.

The hypothesis to be tested would be to see if attitude scores (as measured by my attitude inventory) could be significantly increased over the school year as a result of this preparation.

The New Experiment

Although this second experiment took place during a new school year, and with new classes containing new students, the structure of the school and of the classes were the same as for the first experiment. For the second experiment three classes were used as before which were designated E-89A, C-78B, and R-89C. The curriculum for all three classes was the Long Beach Materials. All classes held Glasser-type [14] meetings weekly or as often as needed for as long as there was interest. During the entire year there was no contact with parents of members of Group C; and this group showed essentially no interest in the class meetings. At the beginning of the year, members of Groups E and R were given the Parent Questionnaire for their parents to fill out. The return was moderate, so personal contact was made with the parents by phone (see sample of questionnaire attached as Appendix E). Because the personal interviews were more in-depth than were the written questionnaires, more information was obtained through these calls. There were three major outcomes: 1) discussion of the Long Beach Materials with the parents was permitted and it was felt that as a whole the parents approved of the material; 2) it was learned that some parents wanted their children to be prepared for pre-college vocations; 3) two special programs were developed. The special programs were a) a student employment service, and b) a program of individualized field trips for students which

consisted of spending a day on the job with a person in a vocation of the student's choice. Details of the programs will follow.

The correlation of math attitude scores with scores on a test of general attitude toward school would be made to provide a measure of concurrent validity for the math attitude inventory. The general attitudes toward school would be defined in terms of and measured by scores on the "Attitudes Toward Any Institution" (Shaw [12]). The institution would be our school.

The survey of general attitude toward school would be administered in this manner: the students would be surveyed orally in class under peer pressure, a small random sample of students' responses being surreptitiously recorded individually; then the students would be surveyed non-orally by writing their responses privately.

Further calls were made to parents on an individual basis only, usually if a student was having personal or academic problems.

Tests of achievement (the diagnostic of Part I), and attitude were to be given at the beginning of the year and at approximately twelve-week intervals for a total of four times in 36 weeks.

The Student Employment Service

This program was designed for members of the experimental and reference groups. It was created in response to

students' needs as expressed in Glasser-type class meetings. It is felt that the impetus for the expression came through the parent-teacher conferences.

Each day members of the group met with the teacher at lunch time to administer the office, to make phone calls for jobs, to get social security information and job permits, and to type and reproduce information for the class. The service remained open for six weeks and found thirteen job openings. No student from the class was placed on a job. The program culminated in a seminar with speeches from the State Employment Service and the Student Work Experience Office of the School District. Twenty-eight students from the school attended the seminar, two of whom were from the experimental class, three from the reference class.

The Individualized Field Trips

This program for the experimental and reference groups was suggested by the parents, presented to and adopted by the students. Adult members of the community were asked to have a student accompany him for a day on the job. The students were to be given as much practical on-the-job experience as possible and questions answered. A list of twenty-one volunteers was compiled and ten students took advantage of the offers. Volunteers were solicited by the teacher and he made appointments, arranged for transportation, contacted the parents for permission for the field trip, and in the case of each student saw to the indemnification of

the school district against liability in case of injury to the student.

Field trips experienced by students included:

1. A beauty shop
2. Public health nursing
3. Office work
4. Real estate
5. Art studio
6. Doctor
7. Civil air patrol
8. Sugar plant
9. Employment office
10. Dance studio

Results

An examination of Table 5 shows that attitude scores went steadily and uniformly down as the year progressed.

Table 5

Mean Attitude Scores by Class

Class	Date	Mean
Experimental	10-8	22
	12-6	22
	4-7	19
	6-9	18
Contrast	10-8	26
	12-6	27
	4-7	24
	6-9	24
Reference	10-8	21?
	12-6	20?
	4-7	21
	6-9	19

A comparison, however, with Table 6, indicates that while attitude was going steadily down achievement was going up significantly.

Table 6

Comparison by Class of Achievement and Mean Gains (Sept. to Apr.)

Class	N	Pre-test mean	Post-test mean	Mean gain	t-ratio
Experimental	29	24	34	10	7.8*
Contrast	29	15	26	11	7.1*
Reference	24	9	16	7	

*Significant at 0.005 level of confidence.

The correlation of the math attitude scores with the students' attitude toward school was found to be r = 0.28.

Other Results

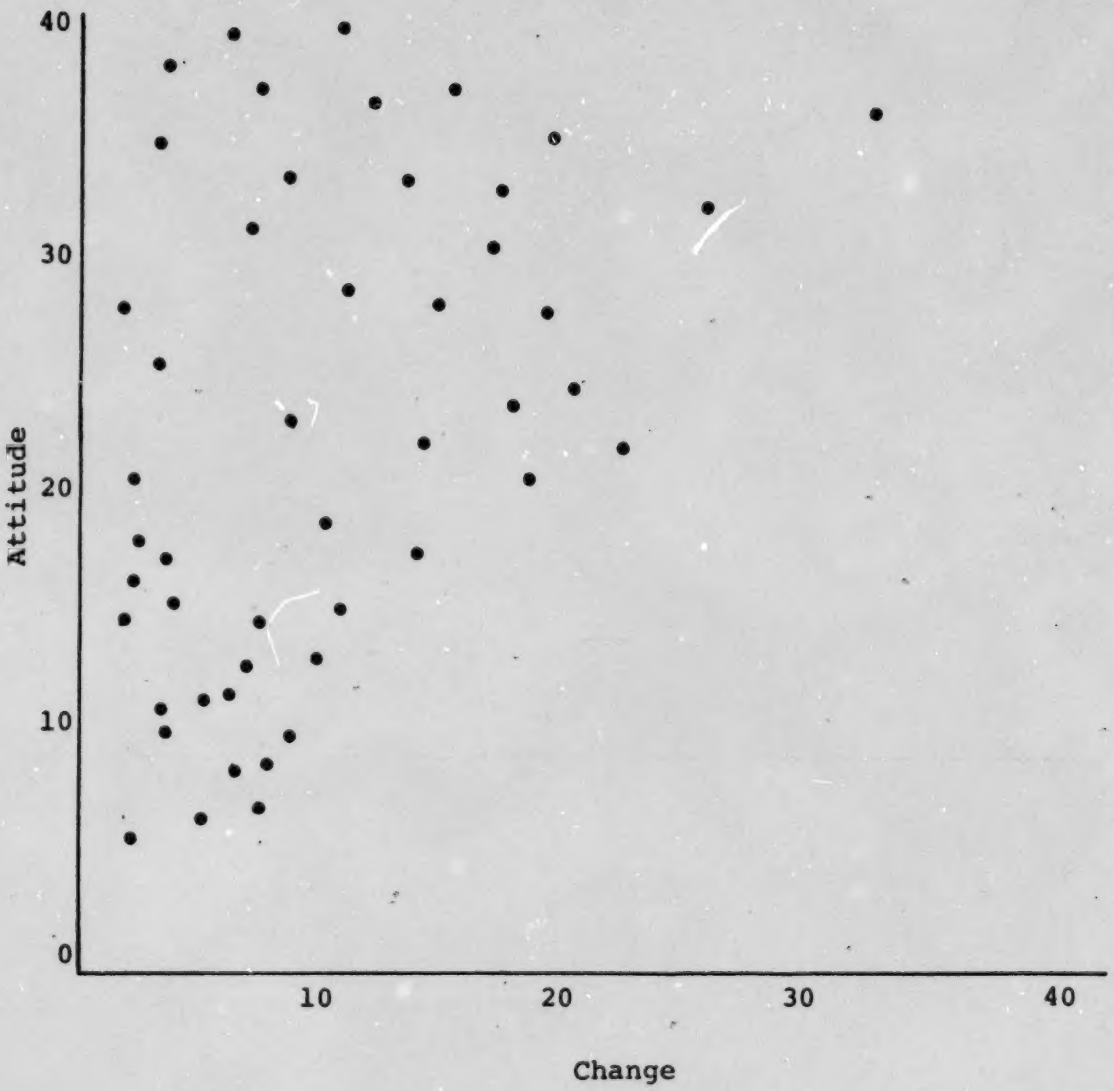
1. For the most part, attitude and achievement do not seem to go hand in hand. In fact, the indication from the second experiment is that in terms of class means good or excellent gains in achievement will be accompanied by losses in attitude (compare Tables 5 and 6).

2. Scatter Diagram I shows that attitude scores were high in proportion to achievement change scores. This tendency could produce low attitude-achievement correlation coefficients.

3. Scatter Diagram I also indicates that a student might have a high attitude score despite low achievement;

Scatter Diagram I

Math Attitude vs. Change (Ach.)



High attitude on the low side of achievement but no low attitude on the high side of achievement.

the converse is not true--high achievers do not have low attitude scores.

4. Scatter Diagram II shows, in spite of low correlation of math attitude scores with school attitude scores, a similarity in pattern with Scatter Diagram I, i.e. high attitude on the low side of achievement.

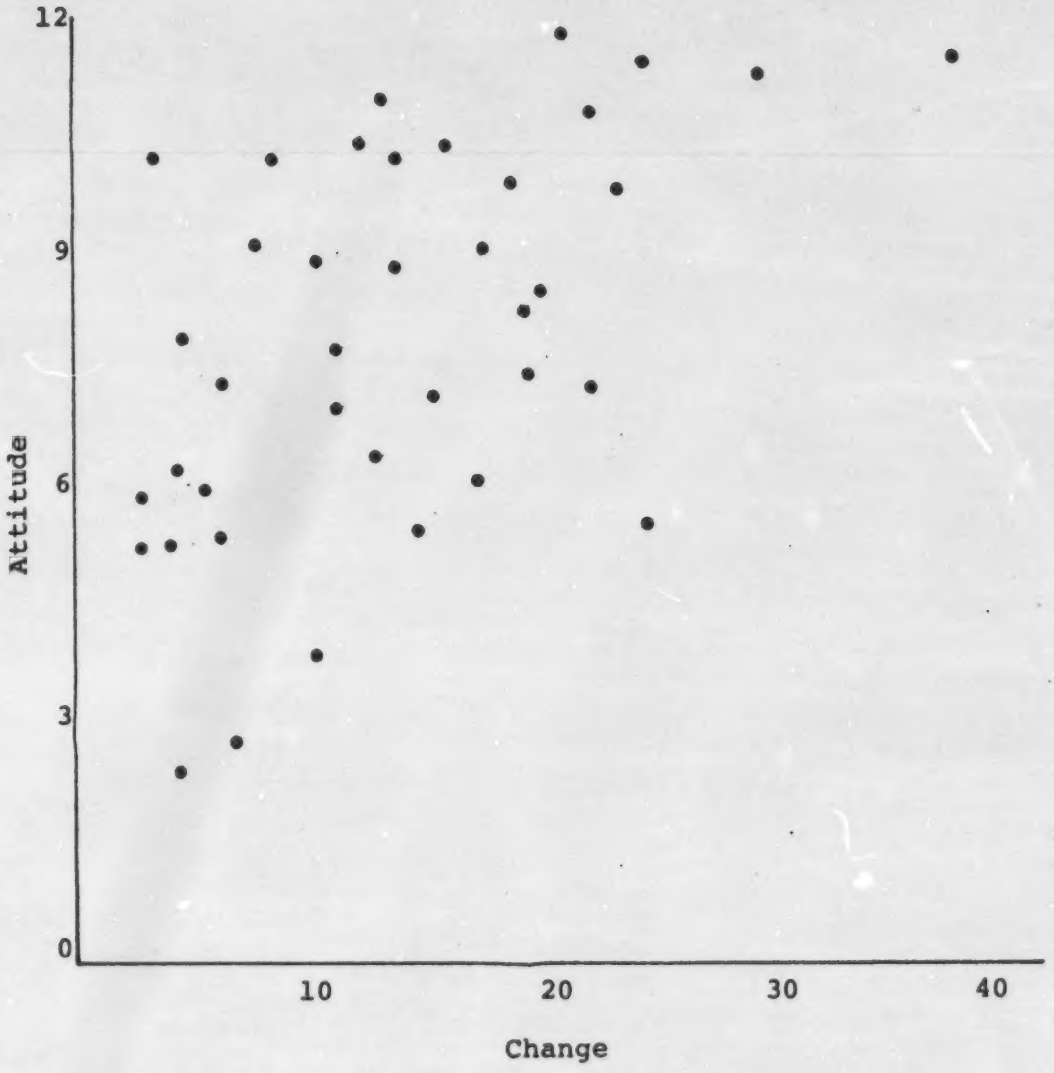
5. Scatter Diagram III gives a correlation of math attitude with school attitude.

6. Scatter Diagrams IV and V illustrate the move downward in attitude accompanying the move upward in achievement.

7. Scatter Diagram VI gives, finally, some meaning to the low correlation of attitude with achievement. Here instead of plotting concurrent raw attitude and diagnostic scores against one another, or of plotting achievement change scores with concurrent new (raw) attitude scores, we have attitude change scores plotted against achievement change scores. And here another pattern emerges. Figure II (page 25) shows that low gains in achievement are accompanied by a high ratio of negative attitude gains over positive attitude gains; that as achievement increase gets bigger, the ratio of positive to negative attitude change gets higher--up to an optimal high. Then the ratio of negative to positive attitude growth begins to increase again as the achievement gains get larger.

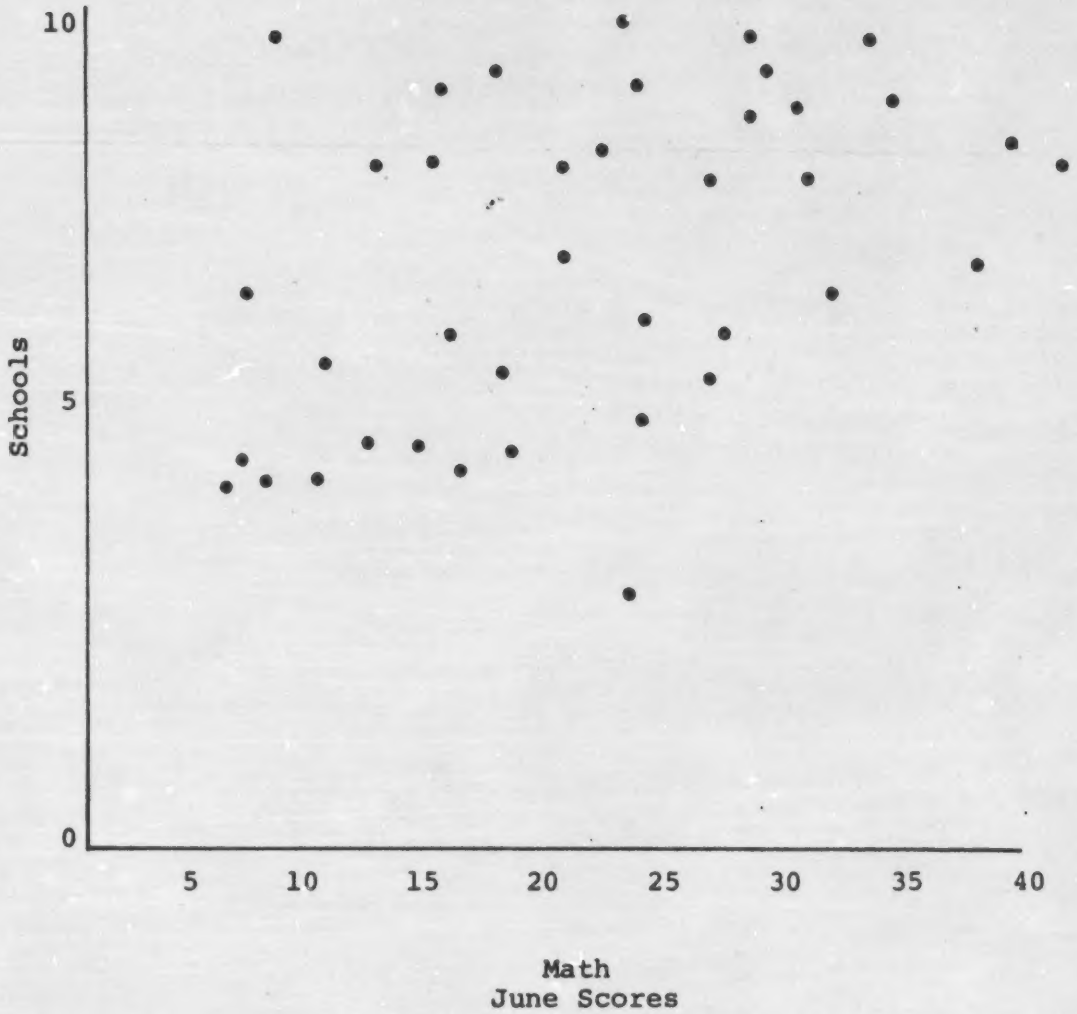
Scatter Diagram II

Written School Attitude vs. Change Scores (Diagnostic)



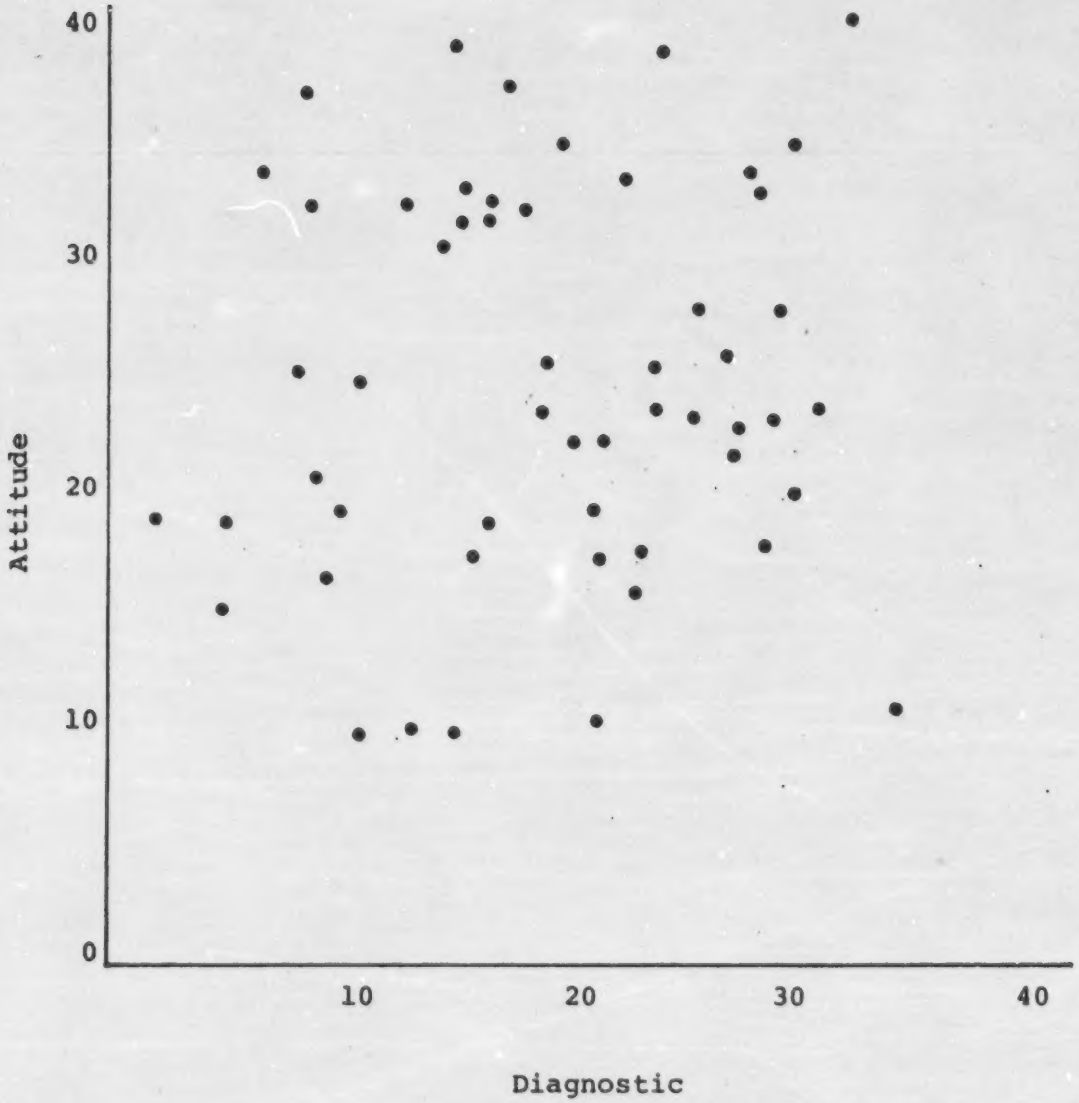
Scatter Diagram III

Attitude Toward Math Class vs.
Attitude Toward School



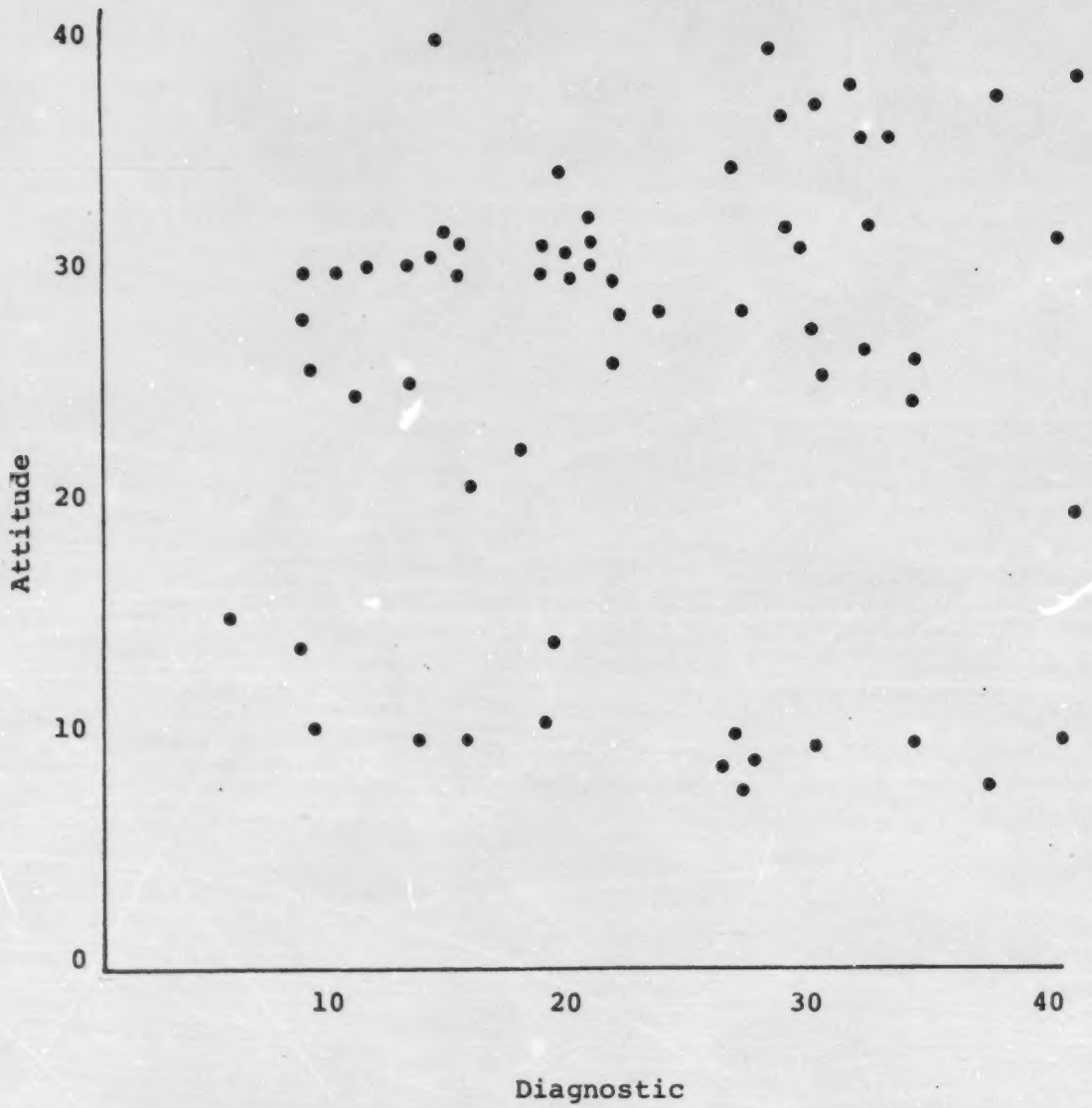
Scatter Diagram IV

Attitude vs. Diagnostic Score
(Sept.)



Scatter Diagram V

Attitude vs. Diagnostic Scores
(Apr.)



Scatter Diagram VI

Attitude Change vs. Diagnostic Change
(Sept. to Apr.)

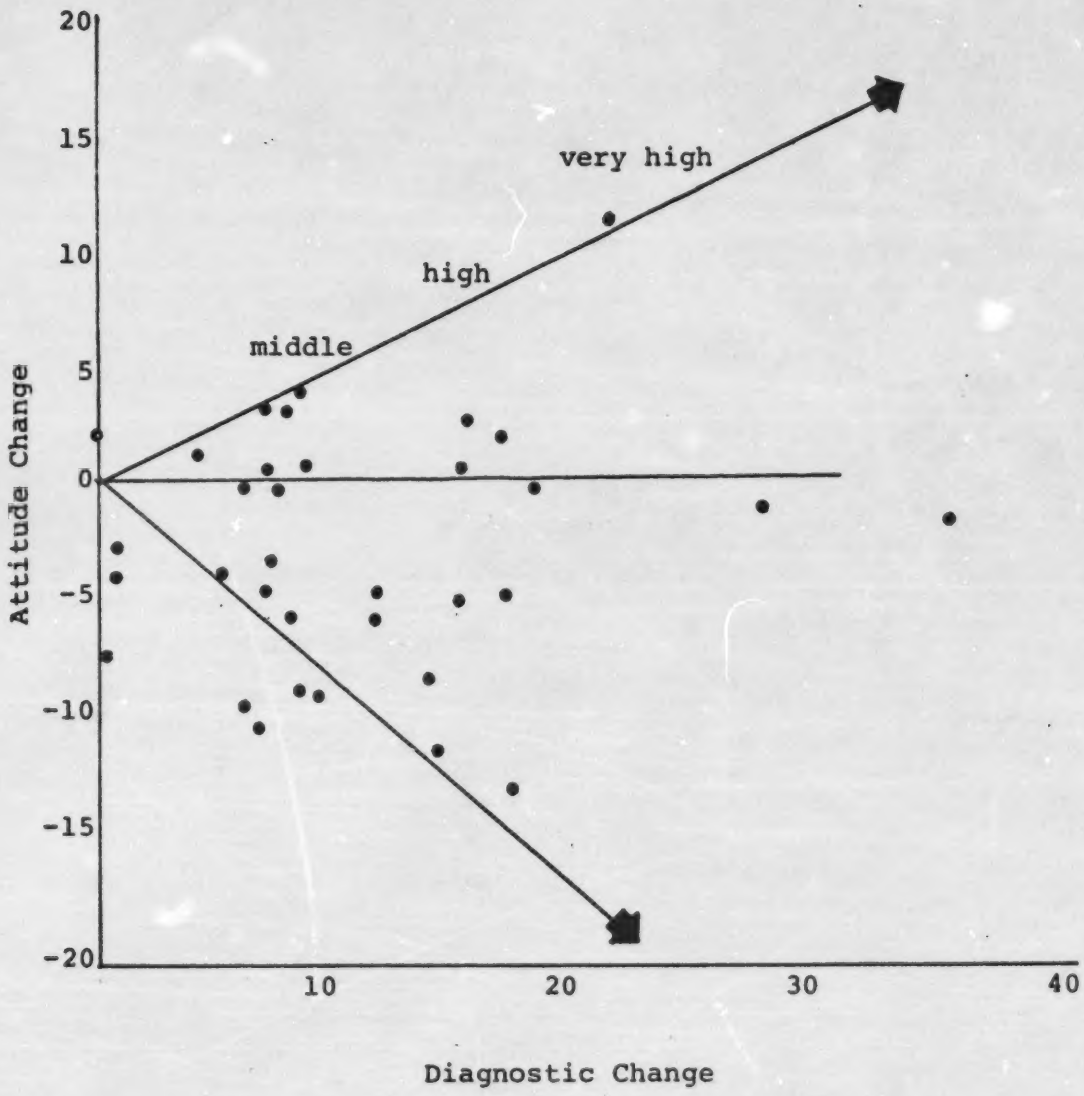
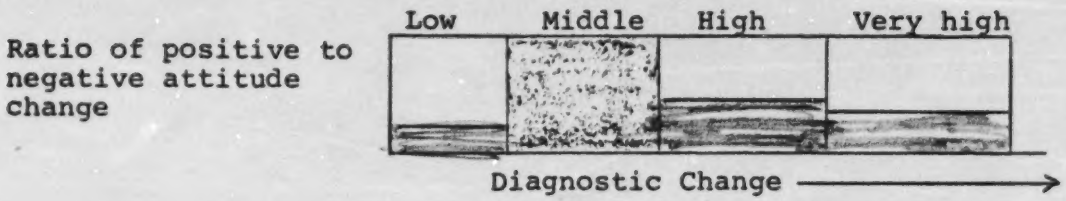


Figure II. Attitude Change vs. Achievement Change



What else arises from Scatter Diagram VI is that as achievement increases (beginning from zero) the numbers of both positive attitude changes and negative attitude change scores increase, up to an optimal level. And then both negative and positive change scores begin to decrease, but the negative scores decrease more slowly.

From the previous paragraph it is clear why we cannot have high correlations (either positive or negative) of attitude with achievement.

Summary and Discussion

This study began with the hope of finding curricula that would improve math attitude. This hope was attended by the assumption, based on widespread belief, that improving attitude toward a subject and toward the studying of that subject (in particular math) would facilitate learning (Neale [2]). In two experiments using two different treatments, the treatments failed to produce significant improvements in attitude mean scores. However, the basic math curriculum, the Long Beach individualized material, demonstrate an excellent ability to improve achievement scores, and as a result of this work has become adopted by the school as a

regular part of the school's curriculum.

Furthermore, achievement and attitude were found not to correlate.

There could be two possible explanations for this poor correlation: first, it was possible that the attitude inventory was simply not valid; or secondly, it is possible that the assumption that attitude improvement implies improvement in learning, or even the converse, that high achievement will produce a more positive attitude, simply are not true.

The first case, I decided, did not apply. I have already argued that the attitude inventory is valid. The fact that it does not correlate well with achievement only proves that it does not correlate well with achievement. And the fact, even, that it does not correlate well with school attitude proves, similarly, only that it does not correlate well with school attitude. A better measure of validity would be a correlation of this math attitude inventory with another such inventory. However, none was available to me. In lieu of some other, however, I could correlate my own test instrument with my own test instrument. This I did in two ways--by content analysis and by split-half reliability estimates. These coefficients were high. The test is valid.

The second case would be hard to sell as witness Neale's report [2] and Aiken [4,13]. In the last paper Aiken misquotes and misreads Neale. He makes concessions,

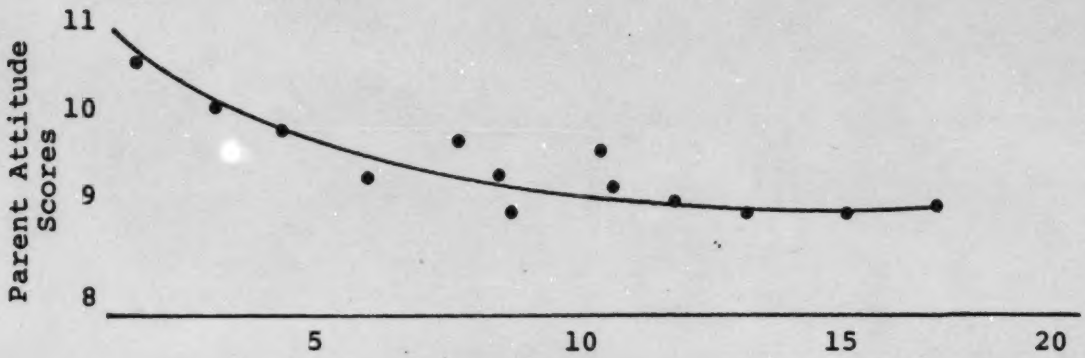
but very reluctantly. He cannot accept the fact that students can achieve and not like the subject, or that they can like the subject and not achieve. Yet both of these premises are true. My study bears them out. Neale supports them.

Further Research

The second experiment, it may be noted, was an attempt to improve the students' attitudes by pleasing the students' parents. The parents were asked about their wishes for their child's education, an attempt was made to fulfill the parents' wishes, and the child's attitude change score was noted. But no attempt was made to measure the parents' attitude in order to see if, indeed, we were pleasing them. It seemed desirable to do so; however, the experiment was over. This work would have to be done in further research. As a prelude to this further research the following study was begun:

In a pilot study using a sample of nine parents as respondents to the same student questionnaire "Attitude Toward Our School as an Institution" (Appendix E), and plotting scores against student achievement change scores, the graph presented as Figure III was obtained. On the basis of this small sample it appears possible to predict a student's achievement from his parents' attitude toward the school as an institution. Interestingly enough though, the correlation is negative--the more negative the parents' attitude, the more the child achieves. This might mean that parents with negative attitudes toward the school are

Figure III. Student Achievement Change Scores vs. Parents' Attitude Toward the School.



simply more demanding, both of the school and of their children, and that the children whose parents require much produce much, while children are easily satisfied with low achievement if their parents are easily satisfied with their child's low achievement.

Table 7 indicates, moreover, that in terms of attitude toward school, a student's attitude score never exceeds his parents'. Table 8 shows a random sample of nine students'

Table 7

Achievement Change vs. School Attitude

Achievement Change	Parent School Attitude	Student School Attitude	
		Written	Verbal
17	9.1	8.2	3.5
12	9.3	9.3	8.2
11	9.3	8.5	8.2
10	9.8	9.8	9.3
8	9.8	9.8	8.2
5	9.7	4.5	4.5
3	10.2	4.5	3.9

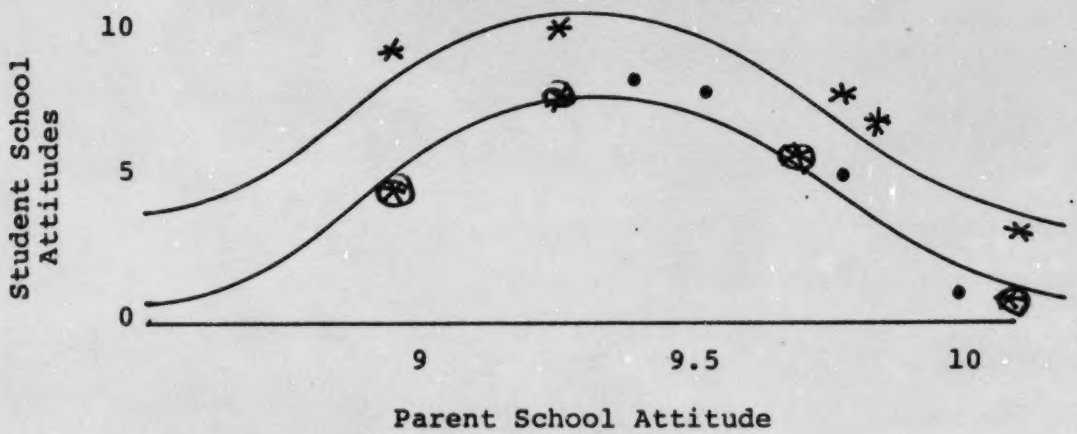
Table 8

Students' Attitude Toward School

Written	Verbal
9.8	9.3
9.8	8.6
9.8	8.2
9.8	6.1
9.3	8.2
8.8	5.2
8.2	3.5
7.4	3.9
4.5	3.9

scores and indicates that a student's score on the attitude toward school inventory is significantly lower when he responds orally in class than when he responds to the same test in writing. This negative influence of peer pressure is also pointed by Figure IV.

Figure IV. Students' School Attitude vs. Parents' School Attitudes



* Student School Attitude Written

⊛ Student School Attitude Verbal (in class)

But Figure IV has another aspect--the aspect of a bell-shaped curve. What is surprising about this curve is

the fact that student attitude gets more positive as parent attitude gets more positive until parent attitude exceeds what appears to be a norm, and then student attitude becomes increasingly negative. What the figure seems to say then is that the children of "normal" parents have more positive attitudes--that as a parent's attitude becomes more radical (either in a more positive direction or in a more negative direction) the child's attitude becomes more negative.

It would be interesting to see a comparison of student math attitude with parent math attitude if successful measures could be devised.

Personal Remarks and Prognosis

I believe that further research in all of the foregoing areas could be productive toward the understanding of the etiology of attitudes in junior high students as well as toward the prediction of successful achievement.

As a result of this study I now perceive adolescent attitude (general or specific) as a victim of the developing superego, to use Freud's term. In the child, attitudes are borrowed from others and from oneself but mainly from parents. In the adolescent the developing superego strives for independence. Because the teenager is part child, part adult, the parental influence is still very strong. The adult part of the adolescent is still weak and requires support which it gets from the peer group. Because the superego of the adolescent and that of his peers is in a developing, struggling state, attitude is generally negative. Positive

attitudes can be engendered only by paying close attention to the input of parents and peers--few things will have intrinsic appeal to the young adult for he has little integrity of his own.

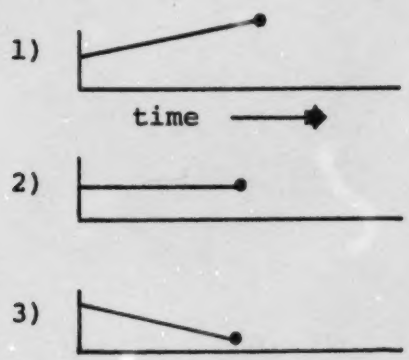
My prognosis would be for the school teacher to allow success for the pupil. (By success I do not mean mere achievement--a student can achieve without <u>feeling</u> successful.) Success, after all, is a personal possession and is something about which the student might at least privately have his own opinion.

Chapter 3

EPILOGUE

Formative Evaluation

An assumption in my work has been that attitude, during the course of an investigation, is a continually increasing or continually decreasing or continually unchanging variable. My procedure has been to give a pretest for attitude, follow with the treatment, and give a posttest to determine the change in attitude. Thus, if a student takes a pretest and scores x, and a posttest on which he scores y, then we take as his change score the difference y-x and a graph of his progress would have one of three general forms:



Personal subjective experiences in the classroom led me to test this assumption.

The Problem

In the school year 1975-76, I undertook in my school

to determine if all the points on a student's attitude chart are indeed on a straight line between point x and point y.

Method: Daily Testing

Each student was given a chart on which to daily rate his math attitude with a number from the scale in Part II, Question B of my attitude inventory (Appendix A).

Groups and Treatment

Five classes were made a part of this study. Three of them, 89A, 89B, and 89C (see page 5 for the meanings of these designations) were taught essentially the same curriculum but did not use the Long Beach Individualzed Lessons. Two of them were individualized using the Long Beach materials and are called Individualized 7 (seventh graders) and Individualized 9 (ninth graders). This information about the classes is not essential to this study but is information which the reader may find useful in a personal examination of the data. Again, the school population is the same as in my previous studies. Also useful may be the knowledge that the individualized classes differed further from the 89A, B, and C classes in that they had the benefit of a full-time teacher's aide with the result that the students received more personal contact with the teacher (and his aide).

Results

The scores from the charts on which daily attitude was recorded were ultimately put into graphical form. These graphs representing in horizontal broken line graphs the attitude changes of students over the entire school year are presented as Displays of Data I, II, III, IV and V at the back of this paper. Corresponding achievement graphs for individual students are to the left of the attitude graphs. Attitude and achievement are represented on vertical axes, time on horizontal axes. Each display represents an entire class with individual student graphs placed one below the other.

Discussion

Little discussion of the data is needed to show that, except in isolated cases, given an x and a y separated by any period of time ranging from several days to a school year, the points between x and y are neither continuously increasing nor continuously decreasing nor continuously unchanged. Rather they are almost continually fluctuating. In fact, one wonders, when looking at these graphs, if minute-by-minute data would not exhibit similarly wide fluctuations. And the need for computing correlation coefficients of attitude with achievements is obviated by a comparison of individual and group attitude graphs with achievement graphs. Clearly the correlation is small. A detailed examination of this correlation, however, will follow under Further Discussion.

Further Discussion

Intelligence from Attitude Graphs

Although the Displays of Data provide evidence that a change score based on one pretest and one posttest is meaningless,* clear indications of trends in attitude are obtainable. For example the fourth graph from the top of Display I clearly is going down and is, generally staying down, while the sixteenth from the top of Display IV is an improved attitude and three from the top (Display III) is down, goes up and comes down again.

Further description of a graph can be made in terms of variance. Thus, I would call the top graph of Display IV one of narrow variance, the top graph of Display III one of wide variance, and the fourth from the top of Display I, I would call middle variance. And here it is time to point out that interpreting these graphs is necessarily subjective. The reader might, for instance, prefer to say that this last graph has narrow variance or he might even want to consider that much variance to be wide. In any case, the user of these graphs will have to set his own limits which will certainly be difficult to define and will probably be arbitrary or a matter of preference. Extrapolation of these ideas of classifying graphs will be taken up later in this section.

Besides being able to say that a student's attitude went up or went down or was changing (went up but then went

*See "Theoretical Considerations" below.

down again, for instance), we can see patterns within a class and from class to class. The Individualized 7 class (Display IV) is generally quite high in attitude and stays high. The 89A class (Display I) has the prominent feature of generally narrow variance graphs at the beginning of the year, becoming wider variance around Christmas vacation, and progressing to what I call extreme high-low form (very wide variance) after the Easter vacation period. And this tendency toward wide variance with time carries from class to class. But this discussion of intelligence obtainable from the graphs must stop here. It is included for interpretation and is not exhaustive because the interpretations are necessarily personal and subjective.

Further verification is needed if my observations or the observations of others are to be of general interest.

Classifying Graphs

My complete work on the classifying of graphs (which I promised earlier in this section) is, however, of interest. Tables 9 through 13 show a class by class breakdown of the attitude graphs according to type of graph. The types I invented were: High, Middle, Low, Extreme High-Low, and Changing.

"High" means a graph begins generally high and stays high. A "low" graph begins generally low and stays low. "Extreme High-Low" is the name given graphs of very wide variance and no other clear pattern.

Each category is further broken down and labeled with symbols:

HW means high with wide variance;

HN means high with narrow variance;

HNO means high with (little or) no variance;

HNS means high with spikes.

Examples of these types are, respectively, third from the top, top graph, sixth from the bottom and second from the top, all found on Display IV. Similar breakdowns are made for Middle and Low graphs. "Changing" graphs are those whose type changes with time. Thus the second graph from the top of Display I is, in symbols, HN → MW → EHL, which is translated "high narrow becoming middle wide, becoming extreme high-low."

Table 9

Attitude Graph: 89A

Middle and High with Medium Variance & Extremely High Change

HW	
HN	3
HNO	
HNS	
MW	1
MN	
MNO	1
MNS	
LW	
LN	
LNO	
LNS	1
EHL	4

Changing

HS → LN → MN	
MN → MW	2
HN → MW → EHL	2
HNS → MW → EHL	
MN → LN	
MN → EHL	
HN → HNS → EHL	
MN → HN → HW	
MN → LNS	
MNO → EHL	
LW → HW → MW	
HN → HW → EHL	
HN → HNO	H = 17
LW → HW	M = 14
MN → HN → HW	L = 7
HN → EHL	EHL = 8
MN → LNO	1 low up
HW → EHL	8 high dn
MN → HN → HW	3 mid dn
HN → LN	2 mid up

Table 10

Attitude Graph: 89B

Middle and Low Attitude with High Variance and Average Change

(A) High-Wide
Narrow //
No

(B) Middle - W ///
N ////
NO

(C) Low - W /
N ////
NO

Extreme high low - 7

Changing

NW → LW
LNS -
MN→EHL 1

LW → MS → LW
HN → MN
LW → LN
MN → NW
LN → HN → MW → EHC
EHC → MNO → LNO → LW → MW
MW → LN
MN → HN
MN → LNOS

3 hi
12 med
11 low
3 EHL
2 low up
1 high down

Table 11

Attitude Graph: 89C

Middle and High with Low Variance and Average Change

HW /
HN /
HNO //
HNS /

MW ///
MN //
MNO
MNS

LW
LN
LNO /
LNS

EHL / (4 wide)

Changing

HW → MW → LN
MW → HW
LN → HN → LW
EHL → MN
HNS → EHL
HNS → LNO → HN
HNO → MW
LN → EHL → HNO → HNS
MNO → HNS → MN
HW → LW → EHL
MNO → HN
LNO → HNS

13 hi
6 med
7 low
4 EHL
4 high down
3 low up

Table 12

Attitude Graph: Individualized 7

Middle & High with Med. Var. and Average Change

HW	///// ///
HN	///// //
HNO	///// (?)
HNS	///// /
MW	
MN	/
MNO	
MNS	
LW	
LN	
LNO	
LNS	
EHL	

Changing

MW → HW → LW
HW → MW → EHL
MW → LNO → EHL → LNO
HW → LNO
HN → LN → HN → MN
LW → HW
HNO → HO → EHL
LW → HW

H = 8
M = 4
L = 7
EHL = 3

4 high go down
2 low go up

Table 13

Attitude Graph: Individualized 9

High with No Variance and Low Change

HW	/
hn	
hno	/
HNS	////
MW	///
MN	
MNO	/
MNS	
LW	/
LN	/
LNO	//
LNS	
EHL	///

Changing

MW → EHL
HW → EHL → HW
MNO → MN
EHL → HNO → EHL
MW → EHL
MN → MNO
LN → LW
MNO → MN
LNO → EHL → LNO → EHL
HNO → EHL → HNO
HNS → LNO
HNS → MW
HNS → LNO → LNS
MNO → HNS
HNO → HW

H = 10
M = 10
L = 6
EHL = 8

4 high down
0 low up

Classifying Groups

It is now possible to classify the groups 89A, 89B, 89C, Ind. 7, and Ind. 9 displayed by type in Tables 9, 10, 11, 12, and 13 respectively. The classification here is done first subjectively as an impression by inspection and then slightly more objectively as a check. The graphs in each group are separated into two groups: (1) changing graphs and (2) those groups which can be described with one symbol, which graphs I call unchanging. An inspection of the list of unchanging graphs in each group leads to the following descriptions of the groups from Tables 9 through 13 in order: middle and high, middle and low, middle and high, high, middle and high. If we use the number of extreme high-low graphs (EHL) as an indicator of variance we can further typify the groups as average, low, high, or no variance. Thus the groups are (in order, again) average, high, low, no, and average in variance. And finally we can say that the groups have change. By computing the percentage of changing graphs in each class, I decided to call 40% to 50% an average change and came up with the following estimates for the change in each class (in order): high, average, average, low, and average. In summary then we have the following descriptions of the groups:

89A (Table 9)

Middle and High Attitude with Medium Variance and Extremely High Change

89B (Table 10)

Middle and Low Attitude with High Variance and Average Change

89C (Table 11)

Middle and High Attitude with Low Variance and Average Change

Individualized 7 (Table 12)

High Attitude with No Variance and Low Change

Individualized 9 (Table 13)

Middle and High Attitude with Medium Variance and Average Change

And now we can compare class attitudes easily. It is clear that the Individualized 7 had the highest group and individual attitudes, that the 89B class had the lowest and that the remaining classes have ascertainable positions somewhere between the extremes.

Substantive support for these class descriptions is derived from a count of symbols by type within the changing graphs of a group. For instance, the changing graphs of 89A contain: 17 highs, 14 middles, 7 lows, 8 EHL. This count supports the group description of middle and high attitude and the high EHL count might go hand in hand with the "extremely high change."

The last count of graphs included in each table is the count of how many changing graphs go from high to low or from low to high. These are submitted for reader interest

and will not be discussed.

Classifying Achievement Graphs

The achievement graphs of each group were also subjectively classed as increasing (UP), decreasing (DOWN), and unchanging (NO) and then more finely classes as

high, middle and low increase or

high, middle and low decrease.

A count of the types of achievement graphs for each group is given in Tables 14 through 18 representing Classes 89A, 89B, 89C, Ind. 7, and Ind. 9, respectively. Some relation (but not correlation; see Theoretical Considerations, below) of attitude with achievement can be seen from a comparison of a group's Attitude Type (Tables 9-13) with its Achievement profile (Tables 14-18). The lowest achievers (in fact, the only declining achievers) are found in the group with the lowest group attitude. Note, however, that the highest achievers (89A) are not found in the highest attitude group (Ind. 7). This will be explained easily from theoretical considerations to follow.

Table 14

Achievement: 89A

UP				
	High	6	30%	
	Med	5	25%	
	Low	3	15%	
NO		3	15%	
DOWN				half
	High			
	Med	2	10%	
	Low	1	5%	
UP - DOWN - UP				
DOWN - UP - DOWN				

Table 15

Achievement: 89B

UP				
	High	1	10%	
	Med	2	30%	
	Low	4	60%	
NO				
DOWN	Hi			
	Med			
	Lo			
U - D - U		1		
D - U - D				

Table 16

Achievement: 89C

UP				
	High	10	40%	
	Med	6	20%	half
	Low	8	30%	
NO		4	20%	half
DOWN				
	Hi			
	Med			
	Low			
U - D - U				
D - U - D				

Table 17

Achievement: Ind. 7

UP			
	High	5	20%
	Med	9	40%
	Low	6	20%
NO		5	20%
DOWN			
	Hi		
	Med		
	Low		
U - D - U			
D - U - D			

Table 18

Achievement: Ind. 9

UP			
	High	7	30%
	Med	6	30%
	Low	4	20%
NO		5	20%
DOWN			
	Hi		
	Med		
	Low		
U - D - U			
D - U - D			

Theoretical Considerations

Change Score Meaningless

The graphs of Displays I-V prove that an attitude change score based on the difference between one pretest score and one posttest score is meaningless. For if we choose almost any of the 150 graphs and an arbitrary day's score as the pretest score, we can find a day within a few weeks subsequent to the pretest day on which the posttest will yield any change score we wish. If we choose a pretest score and a posttest score which seem to best represent the trend of attitude, we are on safer ground; but we must first have the graphs in order to learn what the trend is. Furthermore by noting only the trend we discard a wealth of information between the two tests. In particular, we lose the attitude with respect to a given quantum (or small piece) of the curriculum. I refer to quanta of the curriculum because we

should note that, like attitude over a period of time, the curriculum has discrete aspects (or small portions, quanta) which may affect the attitude differently than do other aspects. In other words, even if attitude were uniform from day to day (and it is not, as I will show later), that is, if attitude were unbiased by influences other than the curriculum then it would still not likely evaluate each day's lesson as uniformly changing from day to day. Or taken from the other vantage, it is unlikely that the curriculum has an intrinsic value which is uniform from day to day. There must be times when the curriculum is better than at other times, and worse than at other times, in terms of the students' attitudes toward it.

Correlation Coefficient and Attitude

The graphs of Displays I-V also suggest that attitude and achievement cannot correlate. In order to positively correlate, as one variable (say attitude) goes up (or down) the other (say achievement) must go up (or down). The more closely the two variables move together, the higher the correlation coefficient. But while almost every achievement graph on the Displays is going up uniformly, each corresponding attitude is changing direction vigorously. In no case is there an attitude graph moving similarly to its corresponding achievement graph. And this is reasonable because whereas we are not surprised to find that attitude can vary greatly day by day, we would be surprised to see a similar

wide daily fluctuation in achievement. Furthermore, as seen abundantly in Display IV, sometimes attitude can move suddenly up to a perfect score. Certainly, achievement cannot approach perfection that easily. And if attitude suddenly then fell off the next day to zero, we would not expect the student's knowledge to follow it. On the other hand, we might hope to find some correlation between a student's daily attitude with how much he learned on a given day. (More will be said about this below under "Implications for Further study.") Or it may be that attitude can lead achievement or that achievement can lead attitude. By this I mean, for example, that one of the variables can go up (or down) and sometime later the other will follow. But this effect cannot be accurately measured by the correlation coefficient, for the reasons stated above.

In addition it must be noted that poor correlation does not prove that improving attitude will not improve achievement or that improving achievement will not improve attitude. What it does prove is that the two variables do not move "nicely" together--that a change in one does not produce a uniform, corresponding, and proportional change in the other.

The correlation coefficient may not be suited to attitude research or to research in any of the social sciences.

Test Making: Item Analysis

In the making of an achievement test we include many

items to sample a universe of knowledge and then correlate individual items with the total test to see which items should be discarded. This practice, which is a meaningful one with achievement tests, has served as prototype for making attitude tests where the practice is meaningless. An area of achievement is usually many-faceted and so a sample from each aspect is useful; but an area of attitude has only one question so the asking of many questions is redundant. Thus my achievement test appropriately includes a problem in addition, one in fractions, one in percentage and so forth--questions which tap the students' knowledge in each level of basic math. But my attitude inventory inappropriately (yet in keeping with general practice) asks, together with the one central question "How do you feel about math," a dozen other questions which to be "good" ones are supposed (by test theory) to correlate well with the overall test (item analysis). But these questions do not add anything to the test except a sort of content validity, and should not be included any more than any achievement test y should be included with an achievement test x where y was given as a measure of validity for x.

Once r_{XY}* is known, we simply record it as a test characteristic and then ignore y in our further use of x. Similarly, once the supporting questions in my attitude test have given a sort of validity to the central and pointed question (Part II, Question B), the correlation of those

*The correlation coefficient for the two achievement tests.

items with the central question should be noted as measures of validity and should then be excluded from the test.

Implications for Further Study

Now that we have a theoretical basis for a one-question attitude test, we have the capability of giving the test on a daily basis and of thereby getting the previously lost intelligence provided by the graphs in the Displays of Data I-V. Moreover, we have the additional capability of including several tests at once to determine how other variables of interest relate, or even correlate, with the central question, "How do you feel about math?"

When discussing the graphs enclosed here with my students, I learned that among the reasons for highs or for lows were the teacher's mood, the subject matter, the weather, the day of the week, birthdays, grades, tests, student moods, amount of work, substitute teachers, social functions, etc. Therefore I have compiled a questionnaire which will consider as many of these other variables as is practical for daily use. (It is attached as Appendix F.) Then any variables which are found to correlate high with math attitude will be noted simply as measures of validity and then dropped from the set. Of greater interest will be those variables which are reputed by the students to be related to attitude but which do not correlate well with attitude; these variables may be the components whose sum produces the daily math attitude score. Or we may learn that the attitude is necessarily a composite of all the factors

producing it and that it cannot be analyzed into components.

Not only should this test produce interesting information in the junior high school, but a comparison of results from various age groups (viz. grades 1-3, grades 4-6, junior high, senior high, adult) should be made in order to get as complete a picture as possible of the ways in which attitudes fluctuate in different age groups.

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APPENDIXES

Appendix A

MATH ATTITUDE INVENTORY

A.

(1) _____ (True-False) (1) I always enjoy math homework.

(2) _____ (True-False) (2) I never enjoy math homework, not even a little.

(3) If your answers to one and two were both false, choose the sentence in the following list which best describes you.

(a) Math homework? I can take it or leave it.
or (b) I often enjoy math homework.
or (c) I usually dislike math homework.

(3) _____

B.

(1) _____ (True-False) (1) I always enjoy math quizzes.

(2) _____ (True-False) (2) I never enjoy math quizzes, not even a little.

(3) If your answers to one and two were both false, choose the sentence in the following list which best describes you.

(a) Math quizzes? I can take 'em or leave 'em.
(b) I often enjoy math quizzes.
(c) I usually dislike math quizzes.

(3) _____

C.

(1) _____ (True-False) (1) I always enjoy math classes.

(2) _____ (True-False) (2) I never enjoy math classes, not even a little.

(3) If your answers to one and two were both false, choose the sentence in the following list which best describes you.

(a) Math classes? I can take 'em or leave 'em.
(b) I often enjoy math classes.
(c) I usually dislike math classes.

(3) _____

D.

(1) _____ (True-False) (1) I <u>always</u> enjoy division problems.

(2) _____ (True-False) (2) I <u>never</u> enjoy division problems, not even a little.

(3) If your answers to one and two were both <u>false</u>, choose the sentence in the following list which best describes you.

(a) Division problems? I can take 'em or leave 'em.
(b) I often enjoy division problems.
(c) I usually dislike division problems.

(3) _____

E.

(1) _____ (True-False) (1) I <u>always</u> enjoy fractions.

(2) _____ (True-False) (2) I <u>never</u> enjoy fractions, not even a little.

(3) If your answers to one and two were both <u>false</u>, choose the sentence in the following list which best describes you.

(a) Fractions? I can take 'em or leave 'em.
(b) I often enjoy fractions.
(c) I usually dislike fractions.

(3) _____

F.

(1) _____ (True-False) (1) I <u>always</u> enjoy decimals.

(2) _____ (True-False) (2) I <u>never</u> enjoy decimals, not even a little.

(3) If your answers to one and two were both false, choose the sentence in the following list which best describes you.

(a) Decimals? I can take 'em or leave 'em.
(b) I often enjoy decimals.
(c) I usually dislike decimals.

II

A.

(1) _____ (True-False) (1) I always enjoy math.

(2) _____ (True-False) (2) I never enjoy math.

(3) If your answers to one and two were both false, choose the sentence in the following list which best describes you.

(a) Math? I can take it or leave it.
(b) I often enjoy math.
(c) I usually dislike math.

(3) _____

B. Rate yourself with a number from the following scale.

0 - I hate math
1
2
3
4 - Math? I can take it or leave it.
5
6
7
8 - I love math.

I RATE MYSELF _____

Appendix B

THE DIAGNOSTIC TEST--GENERAL MATH

I. 1. $\begin{array}{r} 328 \\ +789 \\ \hline \end{array}$ 2. $\begin{array}{r} 4982 \\ 68 \\ 8073 \\ +\ 836 \\ \hline \end{array}$ 3. $\begin{array}{r} 62937 \\ 58185 \\ +07348 \\ \hline \end{array}$

4. $24 + 380 + 6 =$

5. $8427 + 400 + 18 + 302 =$

II. 6. $573 - 491 =$ 7. $\begin{array}{r} 86542 \\ -76568 \\ \hline \end{array}$ 8. $\begin{array}{r} 7{,}000 \\ -5{,}296 \\ \hline \end{array}$

9. $\begin{array}{r} 18888 \\ -\ 9999 \\ \hline \end{array}$ 10. $4002 - 98 =$

III. 11. $\begin{array}{r} 487 \\ \times\ 53 \\ \hline \end{array}$ 12. $3726 \times 28 =$

13. $\begin{array}{r} 5207 \\ \times\ 304 \\ \hline \end{array}$ 14. $\begin{array}{r} 765 \\ \times 325 \\ \hline \end{array}$ 15. $27 \times 2005 =$

IV. 16. $7\overline{)860}$ 17. $51\overline{)357}$ 18. $24\overline{)1345}$

19. $53652 \div 102 =$ 20. $36688 \div 422 =$

V. 21. $\frac{5}{8} + \frac{1}{4}$ 22. $\frac{3}{5} + \frac{1}{3}$ 23. $\frac{5}{6} + \frac{7}{8} + \frac{3}{4}$

24. $6\frac{3}{8} - 1\frac{7}{16}$ 25. $5\frac{7}{12} + \frac{2}{3} + 3\frac{5}{6}$

VI. 26. $\frac{3}{8}$ s $3\frac{3}{4}$ = 37. $2\frac{4}{5} \div 4$ =

28. $3\frac{1}{3} \times 2\frac{2}{5}$ 29. $5_3 \times 6\frac{3}{5}$ 30. $5\frac{1}{2} \div 2\frac{2}{3}$ =

VII. 31. .007 + 65.2 = 32. 1.4 + 00.6 + 60.01 =

33. 28.037 - .0032 = 34. 41.53 - 002.9 =

35. 5738 + 9.0032 + .055 =

VII. 36. $.002 \times 87$ 37. $.48 \times 3.42$ 38. $12.3 \times .046$ 39. $4.2\overline{)8.484}$

40. $.03\overline{)275.4}$

IX. 41. 57% of 23 = 42. 1/2% of 20 =

43. 45 is 300% of what?____ 44. What % of 25 is 5?____

45. 3.5 is what % of 10?_____

X. 46. If a pie is cut into twelve equal pieces, three pieces would be what fraction of the whole pie?

_____

47. You bought a baseball for one dollar and forty-three cents. You gave the clerk $5.00. How much change do you get?_____

48. In a golf game you started out with 4 golf balls. You lost 2 and found 5 more. How many did you end up with?_____

49. You wish to make a board fence 12 feet long and 6 feel wide. How many six foot boards 4 inches wide will you need?_____

Appendix C

THE LONG BEACH LESSONS

Adding Like Fractions

If two fractions have the same denominator, they are called "like fractions."

$\frac{3}{5}$ and $\frac{2}{5}$ are a pair of like fractions

$\frac{1}{6}$ and $\frac{3}{6}$ are a pair of like fractions

$\frac{3}{4}$ and $\frac{3}{5}$ are "unlike fractions."

(1) Pick a fraction from this set $(\frac{1}{2}, \frac{2}{5}, \frac{5}{7}, \frac{7}{12})$ which will pair with $\frac{2}{7}$ as like fractions. _____

(2) Pick a fraction from this set $(\frac{1}{2}, \frac{1}{3}, \frac{2}{5}, \frac{3}{10})$ which will pair with $\frac{2}{3}$ as like fractions. _____

(3) Which of this set $(\frac{1}{5}, \frac{2}{3}, \frac{2}{5})$ will <u>not</u> pair with $\frac{3}{5}$ as like fractions? _____

Appendix D

ATTITUDE TOWARD OUR SCHOOL AS AN INSTITUTION

Following is a list of statements about institutions. Place a plus sign (+) before each statement with which you agree about the institution or institutions listed at the left of the statements. The person in charge will tell you the institution or institutions to write in at the head of the columns to the left of the statements. Your score will in no way affect your grade in any course.

_____1. Is perfect in every way.

_____2. Is the most admirable of institutions.

_____3. Is necessary to the very existence of civilization

_____4. Is the most beloved of institutions.

_____5. Represents the best thought in modern life.

_____6. Grew up in answer to a felt need and is serving that need perfectly.

_____7. Exerts a strong influence for good government and right living.

_____8. Has more pleasant things connected with it than any other institution.

_____9. Is a strong influence for right living.

_____10. Gives real help in meeting moral problems.

_____11. Gives real help me meeting social problems.

_____12. Is valuable in creating ideals.

_____13. Is necessary to the very existence of society.

_____14. Encourages social improvement.

_____15. Serves society as a whole well.

_____16. Aids the individual in wise use of leisure time.

_____17. Is necessary to society as organized.

_____18. Adjusts itself to changing conditions.

_____19. Is improving with the years.

_____20. Does more good than harm.

_____21. Will not harm anybody.

_____22. Inspires no definite likes or dislikes.

_____23. Is necessary only until a better can be found.

_____24. Is too liberal in its policies.

_____25. Is too conservative for a changing civilization.

_____26. Does not consider individual differences.

_____27. Is losing ground as education advances.

_____28. Gives too little service.

_____29. Represents outgrown beliefs.

_____30. Gives no opportunity for self-expression.

_____31. Promotes false beliefs and much wishful thinking.

_____32. Is too selfish to benefit society.

_____33. Does more harm than good.

_____34. Is cordially hated by the majority for its smugness and snobbishness.

_____35. Satisfies only the most stupid with its services.

_____36. Is hopelessly out of date.

_____37. No one any longer has faith in this institution.

_____38. Is entirely unnecessary.

_____39. Is detrimental to society and the individual.

_____40. The world would be better off without this institution.

_____41. Is in a hopeless condition.

_____42. Will destroy civilization if it is not radically changed.

_____43. Never was any good.

_____44. Benefits no one.

_____45. Has positively no value.

Appendix E

QUESTIONNAIRE FOR SECOND EXPERIMENT

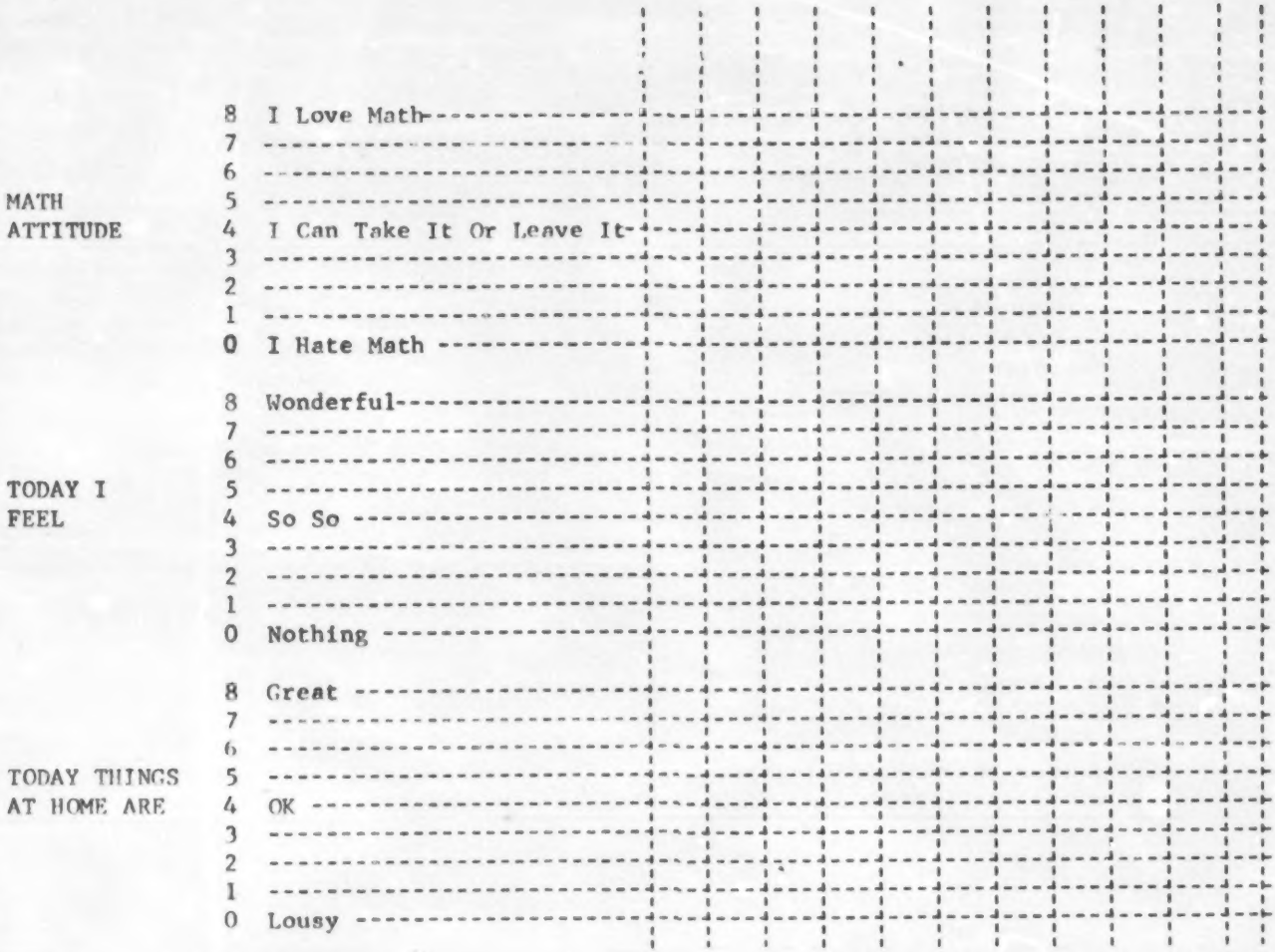
Name of Parent/Guardian_____

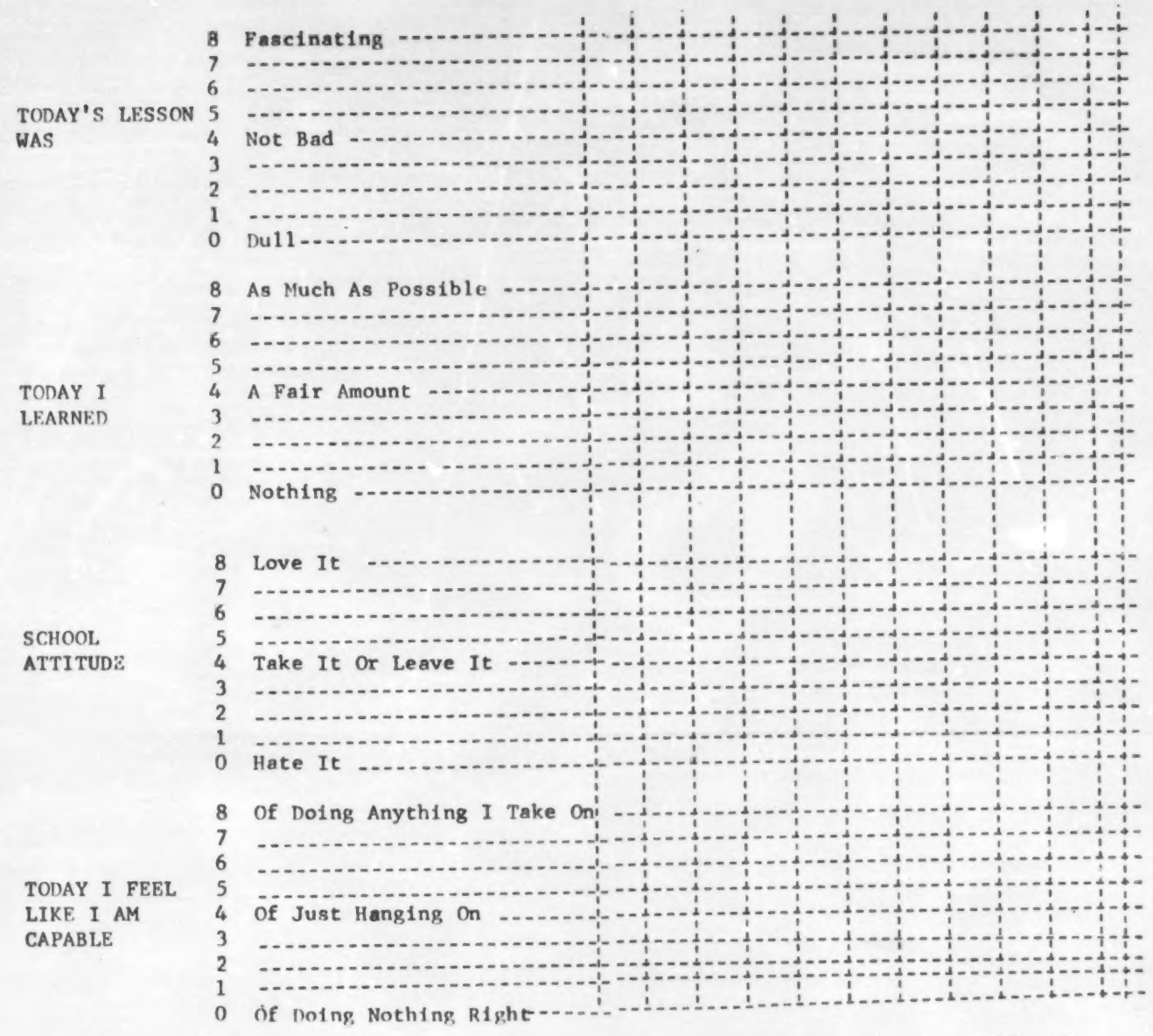
Name of Student_____

Yes	No	Don't Know	
			In math class my child should be prepared for college.
			My child needs to learn math, but not new math.
			My child should play math games.
			My child needs to learn all the math he can learn.
			My child needs to know algebra.
			In math class my child should be learning practical things like income tax computations, balancing a check-book, measuring things.
			My child needs to learn some math.
			If my child works hard in class, he still needs to do homework.
			My child should be prepared for the following adult jobs: _____ _____, _____.
			My child should have the following training in math class: _____ _____ _____.

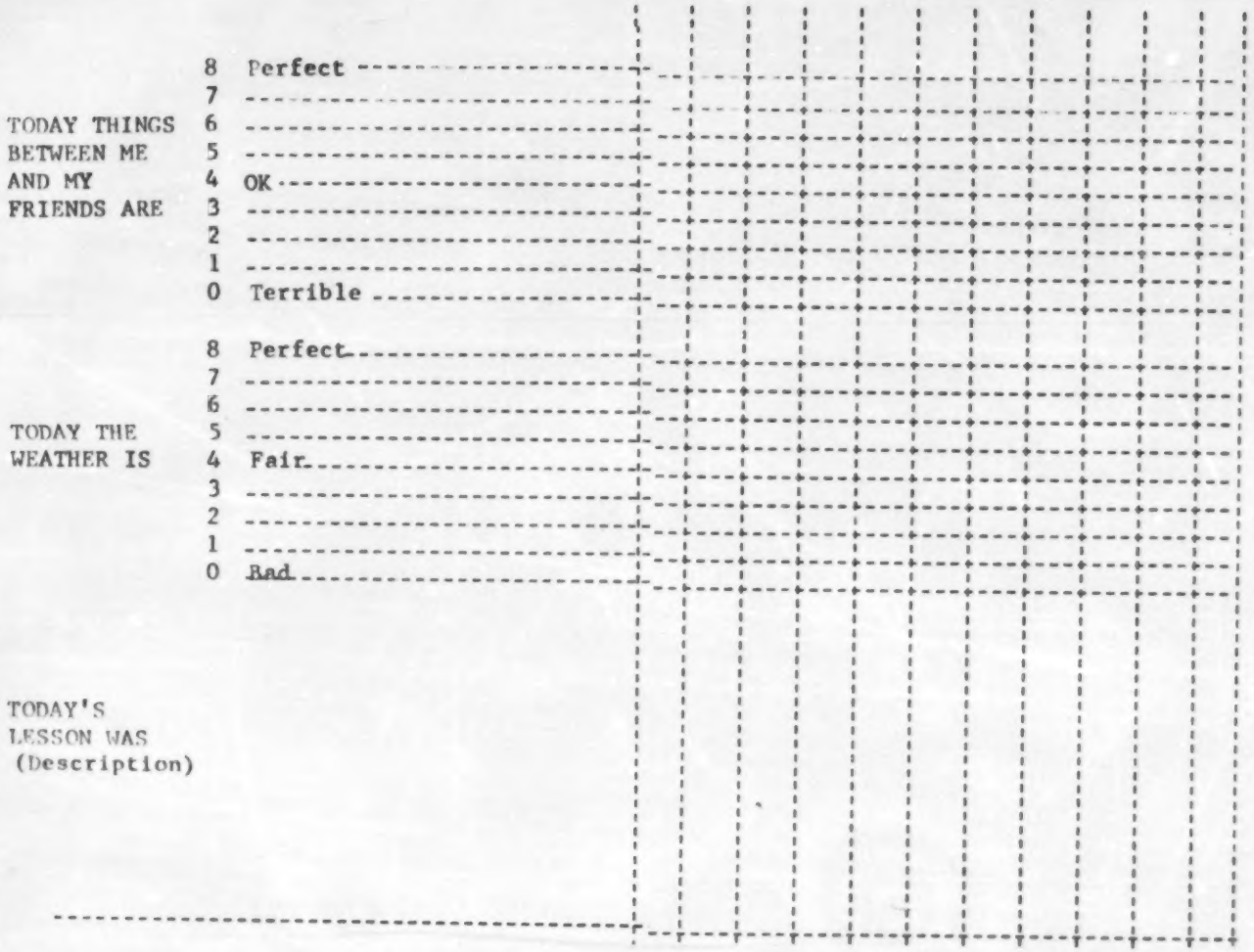
Appendix F

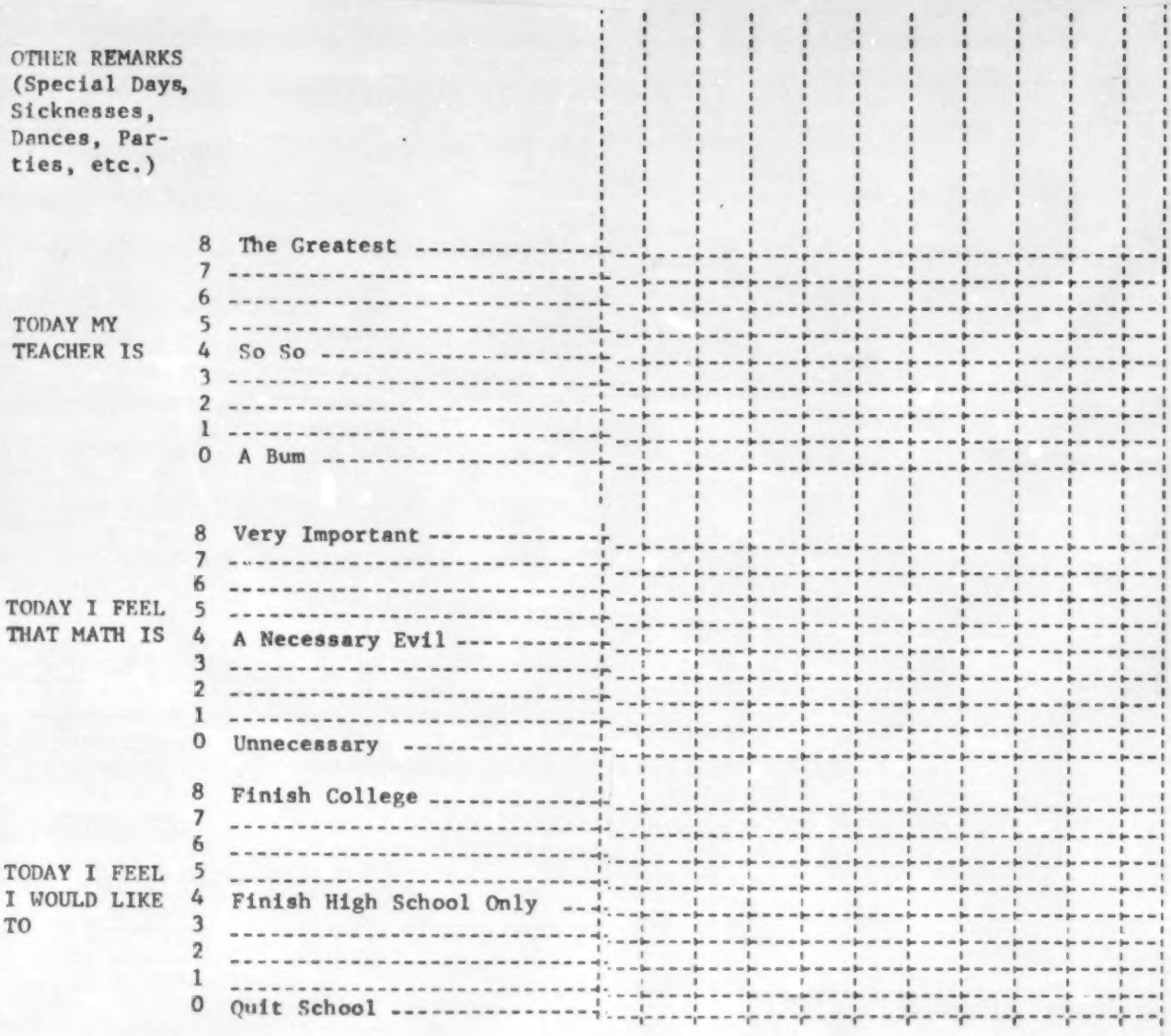
ATTITUDE MEASURE




TODAY'S LESSON WAS
8 Fascinating
7
6
5
4 Not Bad
3
2
1
0 Dull
TODAY I LEARNED
8 As Much As Possible
7
6
5
4 A Fair Amount
3
2
1
0 Nothing
SCHOOL ATTITUDE
8 Love It
7
6
5
4 Take It Or Leave It
3
2
1
0 Hate It
TODAY I FEEL LIKE I AM CAPABLE
8 Of Doing Anything I Take On
7
6
5
4 Of Just Hanging On
3
2
1
0 Of Doing Nothing Right

[continued]


8 Perfect
7
TODAY THINGS 6
BETWEEN ME 5
AND MY 4 OK
FRIENDS ARE 3
2
1
0 Terrible
8 Perfect
7
6
TODAY THE 5
WEATHER IS 4 Fair
3
2
1
0 Bad
TODAY'S
LESSON WAS
(Description)

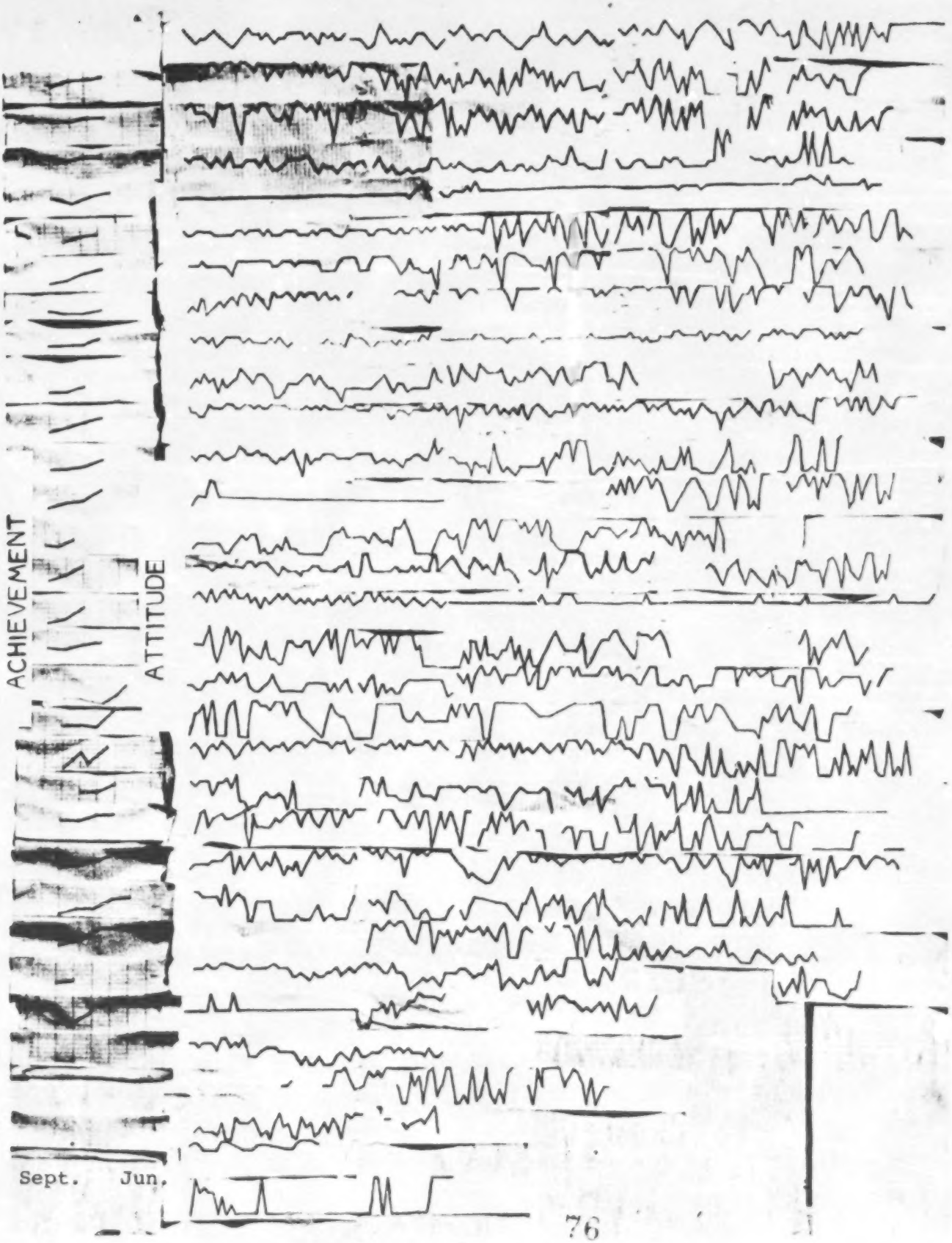

OTHER REMARKS (Special Days, Sicknesses, Dances, Parties, etc.)
TODAY MY TEACHER IS
8 The Greatest
7
6
5
4 So So
3
2
1
0 A Bum
TODAY I FEEL THAT MATH IS
8 Very Important
7
6
5
4 A Necessary Evil
3
2
1
0 Unnecessary
TODAY I FEEL I WOULD LIKE TO
8 Finish College
7
6
5
4 Finish High School Only
3
2
1
0 Quit School

Appendix G

DISPLAYS OF DATA I, II, III, IV, V STUDENT MATH ATTITUDE PROFILE OVER THE YEAR

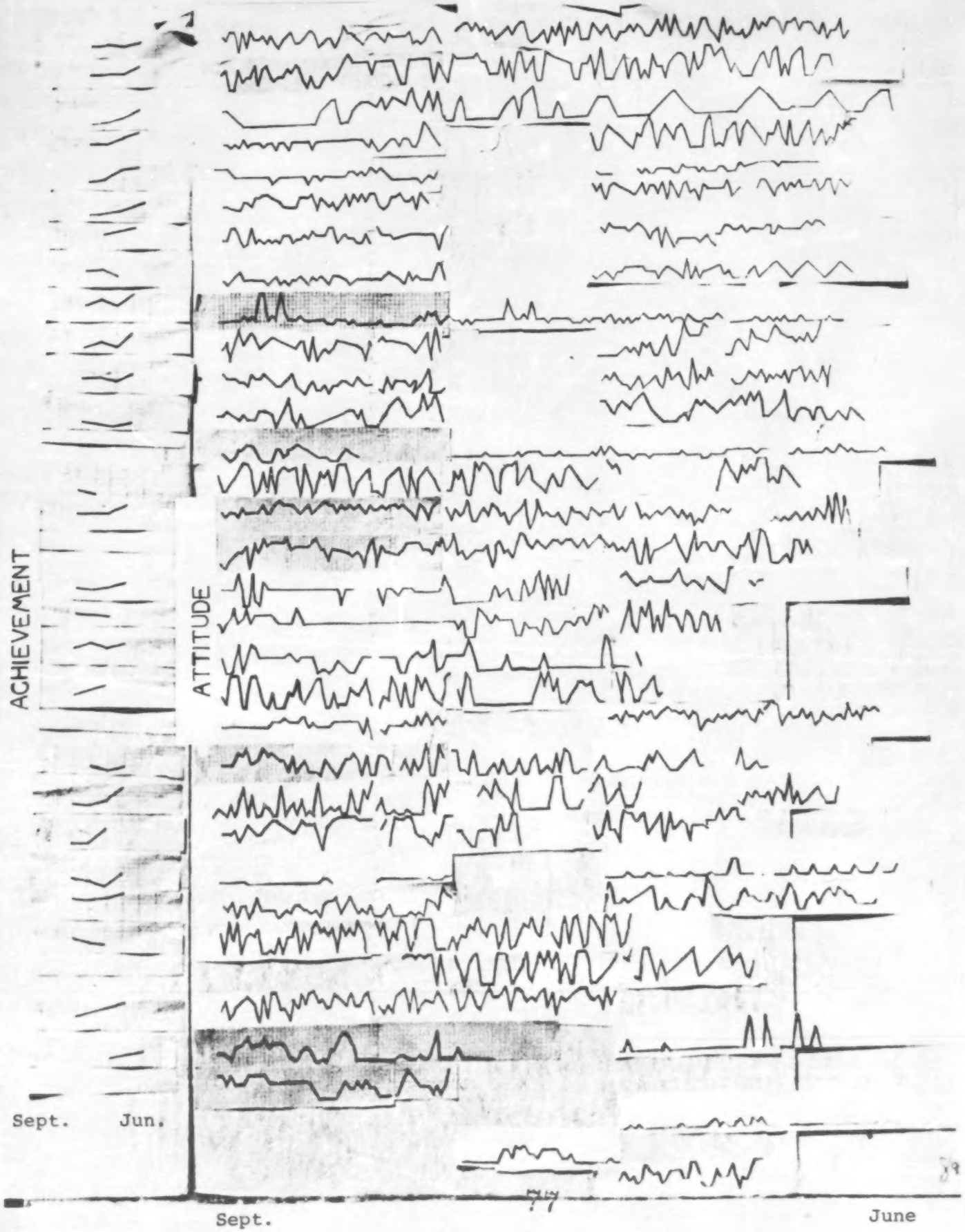
Display of Data I

Student Math Attitude Profile Over the Year: 89A



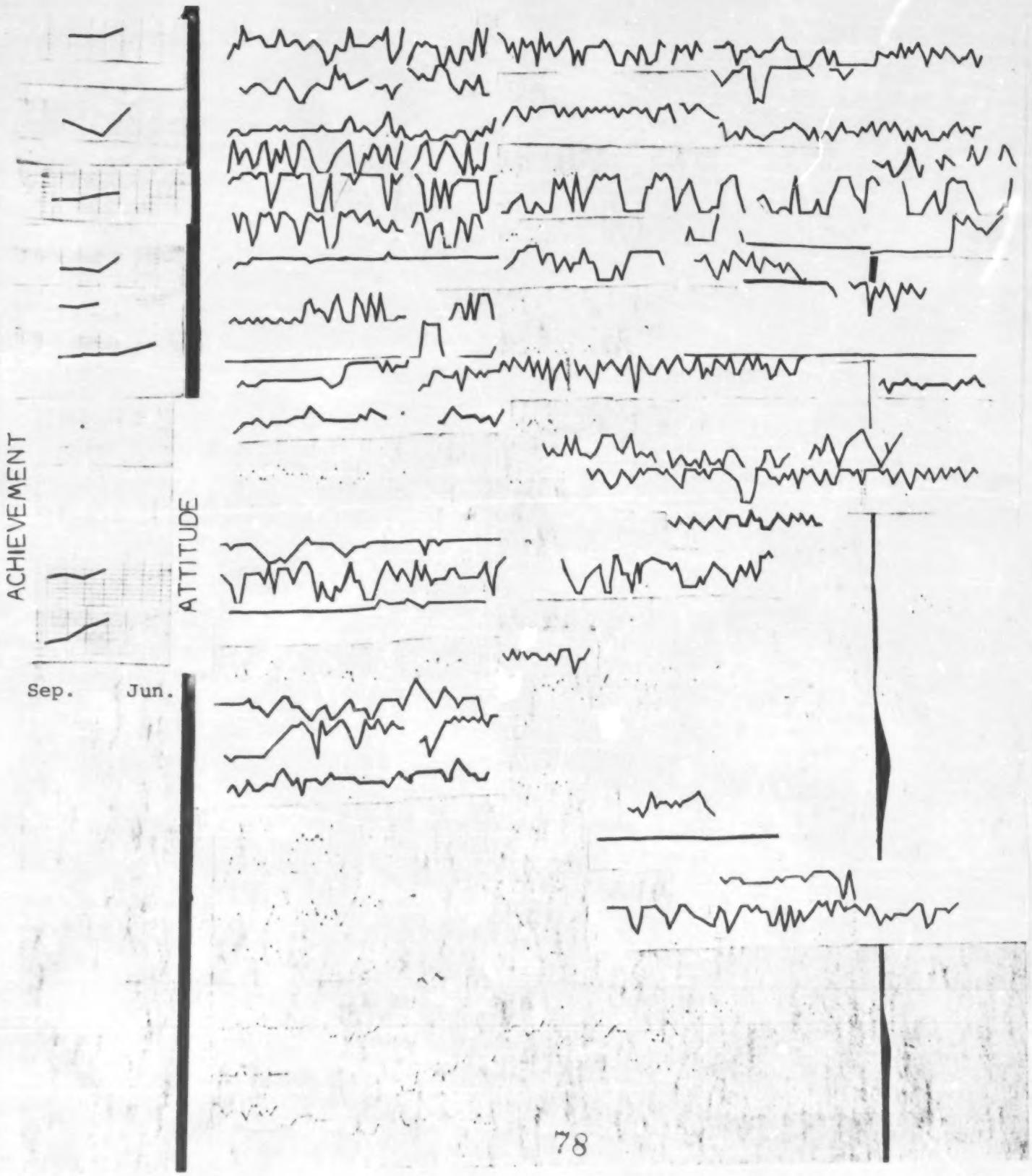
Display of Data II

Student Math Attitude Profile Over the Year: 89B



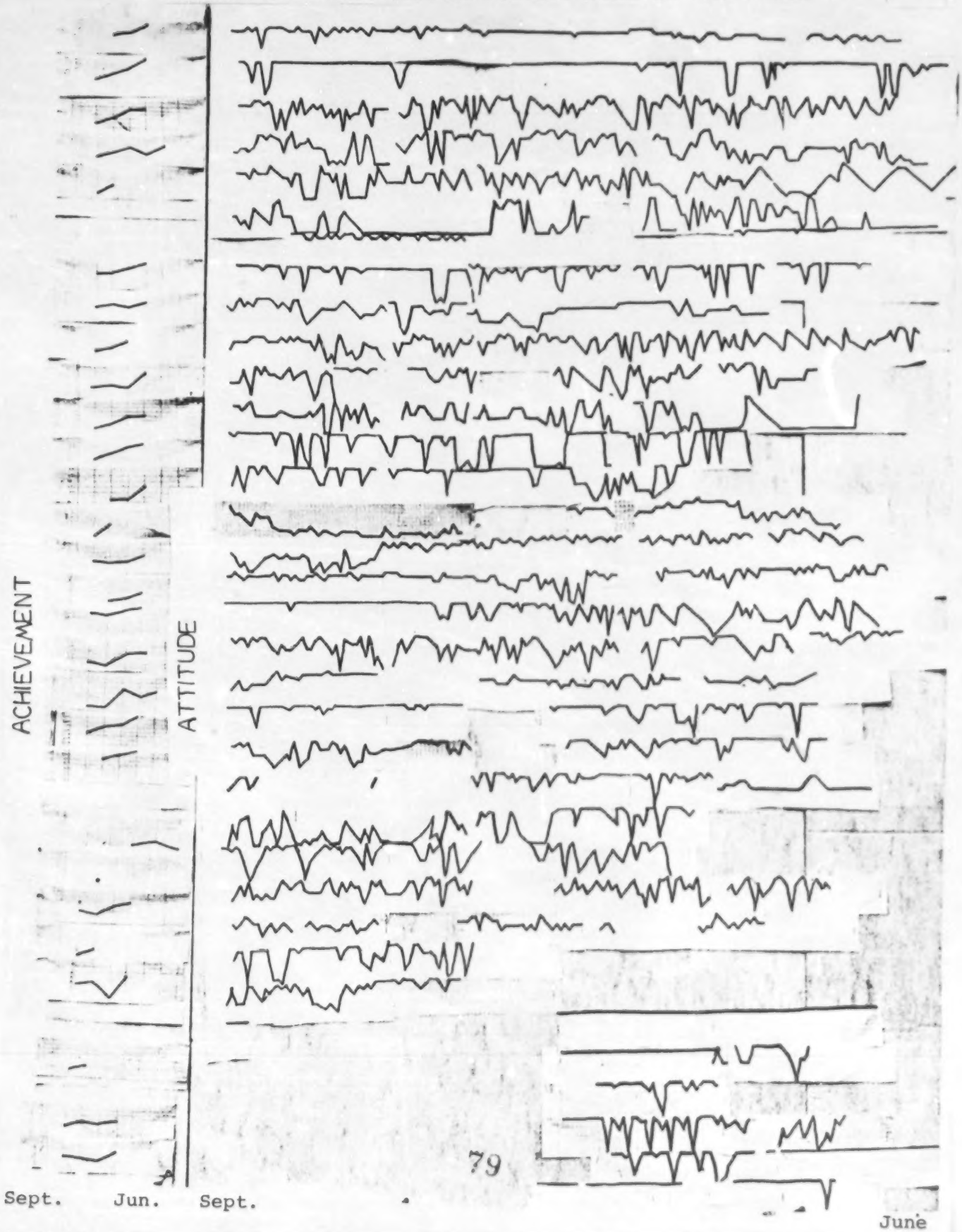
Display of Data III

Student Math Attitude Profile Over the Year: 89C

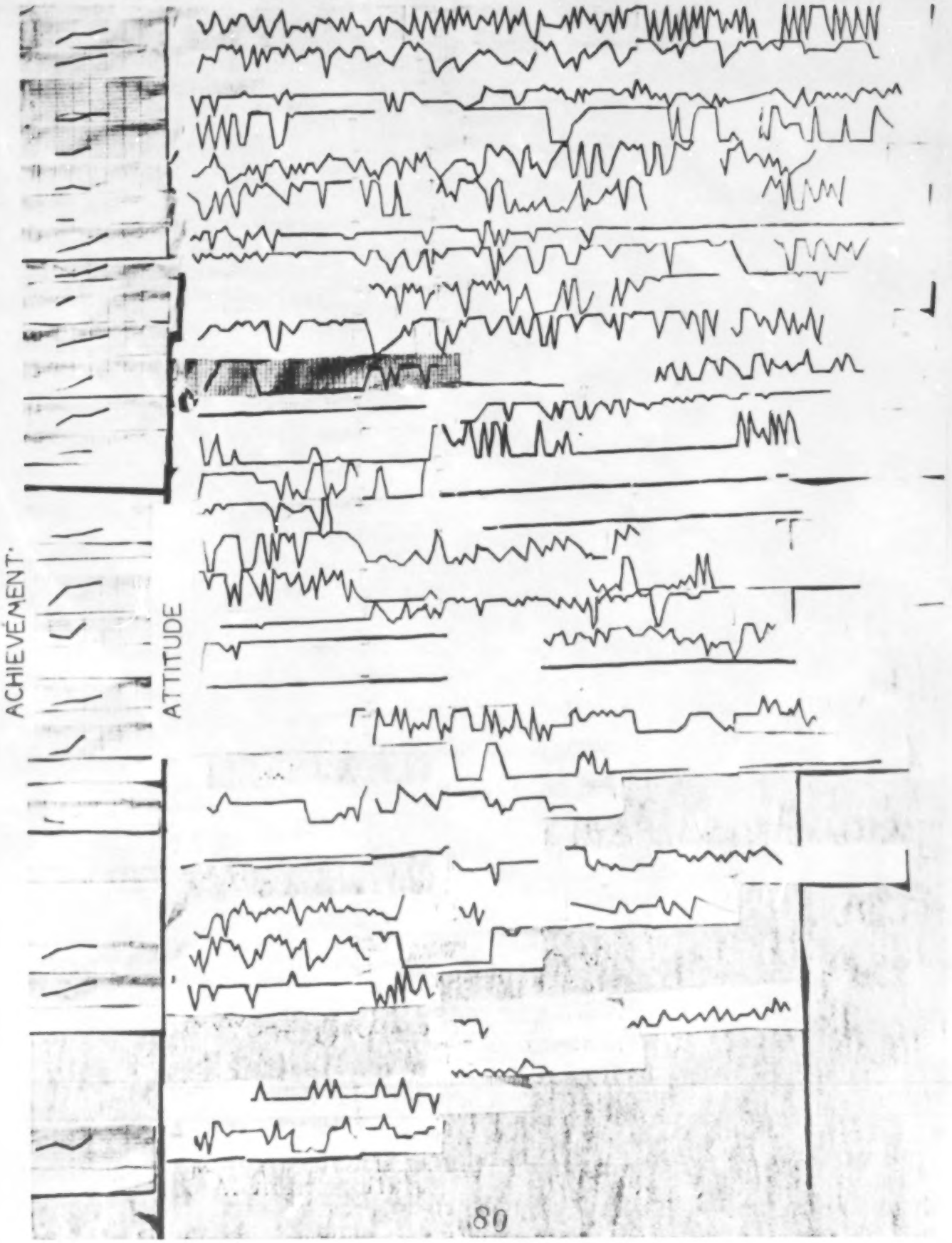


Display of Data IV

Student Math Attitude Profile Over the Year: Ind. 7



Student Math Attitude Profile Over the Year: Ind. 9



Appendix H

DISPLAYS OF DATA VI, VII, AND VIII

Display of Data IV

Student Achievement and Attitude Scores Over the Year: Math Lab Experiment

Contrast Group

Student	Diagnostic				Attitude			
1.	20	-	35	21	35	39	33	30
2.	13	34	44	36	32	38	32	30
3.	13	34	44	36	-	34	27	35
4.	-	19	32	22	-	27	20	?
5.	26	42	44	42	21	26	17	8
6.	17	24	29	19	32	25	31	26
7.	28	24	36	28	20	21	8	8
8.	19	33	36	26	22	22	-	18
9.	29	35	47	39	32	26	26	-
10.	29	24	31	16	24	33	37	-
11.	32	42	44	42	33	28	28	34
12.	20	20	33	13	20	15	16	20
13.	21	18	29	15	0	11	9	7
14.	-	11	-	-	-	7	-	-

Display of Data VII

Student Achievement and Attitude Scores Over the Year:

Math Lab Experiment

Reference Group

Student	Date							
	Diagnostic				Attitude			
1.	-	-	-	-	-	-		-
2.	17	9	18	13	30	-	29	30
3.	-	-	14	11	-	-	25	-
4.	6	9	14	11	?	?	7	-
5.	-	-	16	17	-	-	8	-
6.	16	25	36	24	?	34	32	-
7.	3	1	-	0	20	25	43	?
8.	11	6	13	12	7	-	26	7
9.	-	6	6	7	-	?	-	21
10.	12	-	12	12	20	22	16	26
11.	10	8	12	12	-	30	25	-
12.	9	8	11	8	?	?	7	?
13.	10	-	39	-	-	13	28	-

Display of Data VIII

Student Achievement and Attitude Scores Over the Year:

Math Lab Experiment

Experimental Group

Student	Date							
	Diagnostic				Attitude			
1.	6	16	24	23	12	24	28	31
2.	3	2	-	-	19	28	-	-
3.	26	21	36	32	25	21	16	19
4.	12	8	21	11	7	7	8	9
5.	-	18	17	19	24	29	29	27
6.	17	-	34	17	16	15	16	16
7.	9	7	14	13	25	?	27	23
8.	11	16	22	14	-	32	24	29
9.	19	25	29	27	32	41	22	?
10.	11	16	35	11	19	25	21	17
11.	16	14	25	19	16	13	15	13
12.	19	25	20	23	24	16	11	20
13.	21	24	-	25	20	24	13	12